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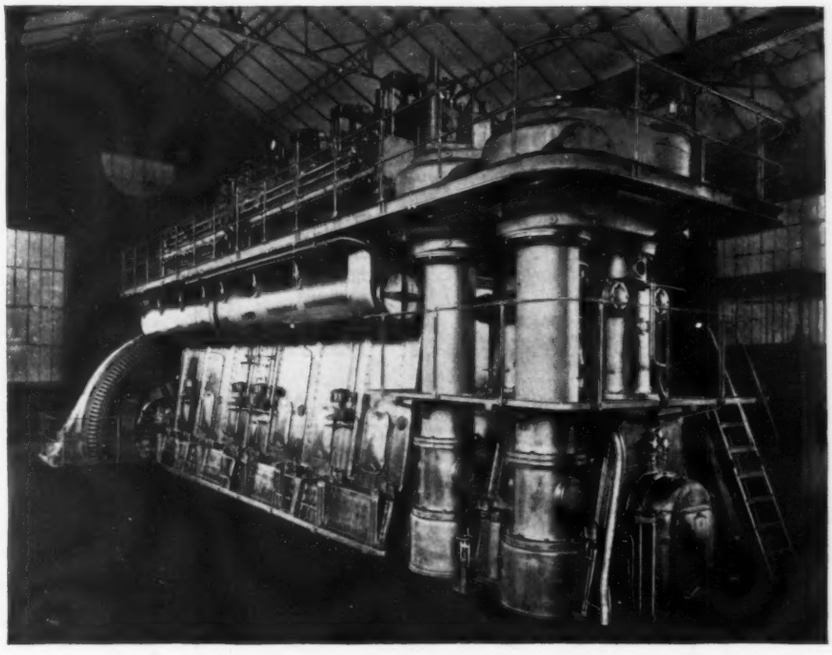

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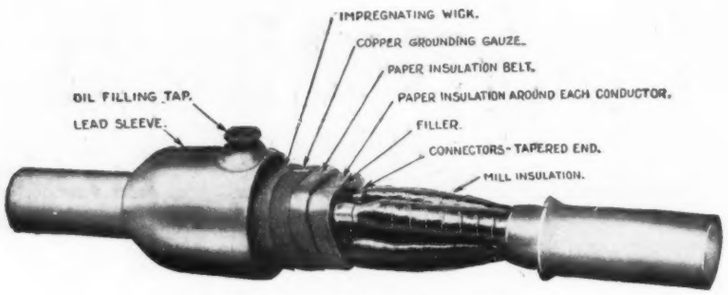

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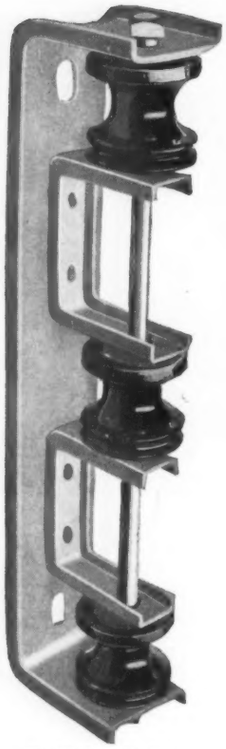

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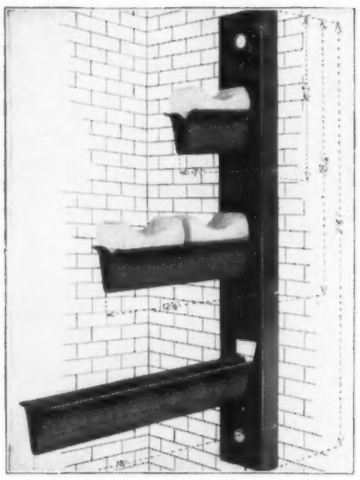

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Bringing the Inspector Into the Family

DURING the past year the electrical inspector has been much in the eye of the electrical industry. We have heard of his right to accept or ignore the code, of his power to favor or oppose new products, of the influence of his work in helping to keep electrical installations safe. But few apparently have stopped to think how great is the opportunity to make him a very helpful influence for creative development in every community by bringing him closer into the circle of the local electrical family.

He has been standing on the side lines as a critic, representing the insurance underwriters or the municipal government. And the other electrical men have been content to allow him thus to isolate himself, forgetting that a little education might make of this neutral a mighty ally in the co-operative effort to interpret to the people the value of higher standards of electrical service.

THE inspector has access to every house where construction work is going on. That is a great privilege. For it brings with it the invaluable opportunity to guide the public to an appreciation of adequate installations, of generous facilities for the use of electrical appliances, and also of a standard of quality in electrical construction that provides a broad margin of safety plus a pride of ownership which is no inconsiderable factor once understood. The electrical industry can well afford to give some thought and time to interesting the inspector in the importance of grasping this opportunity to advise the householder to install better lighting and more outlets and to enjoy a wider variety of appliances.

IN MOST homes there is little knowledge of electrical standards—either of quality or adequacy. Brass pipe and porcelain tubs bespeak quality in plumbing to everybody's mind, but the average man cannot name to you what it is that is the mark of quality in an electrical installation. The inspector is in a peculiarly favorable position to explain.

In Philadelphia, right now, for instance, Washington Devereux, chief underwriters' inspector for that city, ranks as one of the outstanding leaders in the work of public education. In the details of the work that he is doing lies a notable example of what can be accomplished when the inspector functions as a working member of the family instead of as merely a policeman. For as a neutral authority his word carries strongly to the public ear, and he can become a power for progress and achievement both in the bettering of central-station public relations and in the development of a greater use of everything electrical.

Grover C. Neff

A central-station-company executive who has contributed a winning impetus to the movement for farm service.

THE central-station man with a hobby on which he persistently rides is the man who is sure to make a name for himself in the electrical industry, provided that his hobby be a sane and vigorous animal with race-winning propensities in its blood. The hobby that Grover C. Neff, operating vice-president of half a dozen Wisconsin light and power companies which form an important group of Middle West Utilities Company properties, rides is such an animal.

Mr. Neff has been the chairman of the rural electric service committee of the National Electric Light Association since its formation in 1921, and his voice and pen have done great service in giving to this movement the importance it has in recent years assumed. The question of how to serve the farmer is now a topic not only at every convention of light and power men but at every meeting of progressive agricultural societies. The N. E. L. A. committee, under Mr. Neff's leadership, has taken a leading part in bringing together the electrical and agricultural industries in a common study of this problem, and the newly organized Joint Committee on the Relations of Electricity to Agriculture is in large part a result of its efforts.

Mr. Neff is a graduate of Purdue University, class of 1907. He came into the utility business shortly after his graduation as a resident engineer on construction work in Wisconsin. In 1910 he became superintendent of the Southern Wisconsin Power Company, and between 1914 and 1921 became the general superintendent of the Southern Wisconsin Power Company, Wisconsin River Power Company, Wisconsin Power, Light & Heat Company, Mineral Point Public Service Company and Janesville Electric Company, operating hydro-electric stations on the Wisconsin River. He is now operating vice-president in direct charge of these properties and also of the group of properties in eastern Wisconsin known as the Eastern Wisconsin Electric Company which were added to the Wisconsin holdings of the Northwest Utilities Company, another Middle West subsidiary, in 1922. Mr. Neff has been active in the N. E. L. A. overhead-systems and inductive-interference committees and was the chairman of the committee of the Wisconsin Electrical Association which took the lead in formulating the rural-line extension policies and rules now known as the Wisconsin rural-lines rules. He is a member of the American Institute of Electrical Engineers and was chairman of its Madison (Wis.) Section in the year 1920.

Editorial Comment

Electrical World, December 1, 1923

Volume 82 Number 22

Favorable Opportunity for Financing Utilities

THE growth and expansion of the electric public utilities of the country continue unabated. It follows therefore that the utilities will require more and more money to keep pace with demands for service. So far this year 10 per cent more money has been raised than for the similar ten-month period of 1922, the advertised public sales of securities exceeding $570,000,000. The actual amount raised is, however, considerably more than that, since the figure given does not include sales of stock to customers, which normally would approximate $175,000,000. Utilities in the East are spending money for extensions and new equipment as fast as they can raise it, and fortunately the signs point to a favorable money market for some months to come. Interest rates show less than a normal seasonal rise at this time, indicating large accumulations of uninvested funds and presaging better prices for bonds in the immediate future. It would be well for utility managers therefore to give consideration to their financial wants at this time.

Information and Misinformation

ADVANTAGE is being taken of the public interest in "superpower" and "interconnection" to gain some publicity of real value for the light and power industry. Publicity men, public relations men, public utility information bureaus are all at it. The amount of this literature, judging from that part of it which it is possible to collect and see, is somewhat awe-inspiring, at least as to quantity; and, on the whole, it is good work.

But a word of warning will not be amiss. This very public interest, the very political aspect in certain territory, make it doubly important that executives watch carefully this publicity in behalf of the industry to be sure that it carries nothing of misinformation along with its information. Wrong information in the sense of misstatement is hardly to be feared. But wrong conclusions which may be drawn because complete information and facts are lacking may be serious. The subject is important enough for constant executive attention.

How easily, for instance, a wrong conclusion may be drawn with reference to power interchange possibilities wherever two places are joined together by a line on a transmission-line map. That such a line exists or is to be built is not enough information. Unless it has sufficient carrying capacity it is only a beginning. A line from "A" to "D" is good for a large interchange of power only if its middle element—"B" to "C," for example—is as large as its other two elements, "A" to "B" and "C" to "D." In this connection it should be pointed out that the recent map of New York interconnection (see ELECTRICAL WORLD for Nov. 17) can be correctly interpreted only when the capacities of the various lines are considered. The closing of a small gap may not necessarily mean that Niagara power can be transmitted all over the state.

This particular example is not meant to detract from the significance of the New York report. It is used to indicate concretely a danger of misinterpretation by the public—and by unthinking men in the electrical business also—of the possibilities of certain developments. Information is valuable. It is too valuable to allow it to become diluted with misinformation.

The Eternal Question Bobs Up Again

FOR one reason or another the question of coal supply seems to appear with singular regularity at this season of the year. Just now the tracks are blocked with accumulations of bituminous coal, and to avoid too great an overproduction many mines have been shut down. But the first of April looms in the distance, and with it comes the possibility of another coal strike. If, therefore, production is curtailed at this time, there is not much likelihood of any great surplus next spring to bridge the emergency if it arises. This makes it necessary for electric public utilities particularly to keep their eyes on the coal piles and especially on the reserves. It is a pity that they must tie up millions of non-interest-bearing capital in coal piles because of the uncertainty of coal deliveries, but service is service in this industry, and if there is no other way of insuring service, they cannot give up the practice of storing coal in huge quantities until operators and miners cease to quarrel and the railroads function continually.

More Liberal Design of Transmission Towers Desirable

AT FIRST sight it does not appear that it should be a difficult matter to design transmission towers and lines so as to insure their stability and permanence under all conditions. The line, considered as a structure, is normally at rest and is subject only to such varying stresses as are imposed by weather conditions. Other structures of many types are subject to very much wider variations of load and stress, including those due to weather, and stand for years without question or doubt as to their reliability. Steel-tower construction for lines of 60 kv. and upward has been in use for more than thirty years, yet, as is well known, transmission-line failures due to causes other than electrical are not uncommon today. This is especially true whenever a step to a higher voltage is made, entailing wider clearances both between the conductors themselves and between conductors and ground.

There are apparently two principal causes of this seeming reproach to designers of transmission lines.

The first lies in the relatively poor mechanical properties of the line material. Good electric conductors of moderate size have low tensile strength, and the limitations of porcelain due to its want of elasticity and to its low tensile and compressive strength are well known. The second and more significant cause is the predominating importance which is always assumed in every new type of development or expansion by the question of economical design. It is only after a new type of engineering undertaking has definitely proved its value that it is found possible to turn the attention to, and to incur the expense of, obtaining such factors of safety as will definitely insure continuity of service. It appears that we are still in the initial period in the case of transmission lines. Voltages are still going up, the methods and constants used for lines of lower voltage are being used in the design of those for higher voltages, and the cost of the new structure is in most cases being pared so as to limit the new capital necessary to the smallest permissible figure. Obviously, in such a borderland between economy of material on the one hand and the considerable uncertainty as to properties of transmission-line material on the other, there is sure to result an occasional error in judgment and consequent failure of the line in operation.

These thoughts are suggested by the numerous papers on transmission-line construction which have recently appeared and which are doubtless inspired by the great interest now attaching to the higher-voltage lines in their relation to superpower projects. Several such lines are in operation, notably on the Pacific Coast, and the result of experiences in winter operation are indicating their weaknesses and the necessary modifications in design. The troubles which have arisen appear to be largely due to winter weather conditions in the mountain ranges. Not only have lines and insulators failed, but it is interesting to note that the great depths of snow in combination with spring melting have in some places resulted in the failure or serious damage of the tower itself. A particularly striking feature is the indication that the suspension method of hanging the conductor has decided advantages over the dead-end method of attachment, in spite of the greater clearances and increased cost of tower which are necessary. From the standpoint of economy W. Dryer, in the November *Journal of the A. I. E. E.*, shows the important bearing the figure of maximum tension allowed in the transmission conductor has on the cost of the tower itself. It has been common practice to string the conductor under tension nearly approaching the elastic limit. By reducing this stress to 60 per cent of the elastic limit the cost of towers and foundations shows a considerable saving, notwithstanding their greater height, and the failures on dead-end insulator strings are greatly reduced.

There is no question that a transmission line can be designed and constructed to the same degree of reliability as obtains in any other type of outdoor structure. In order to do this, however, engineers must know to a certainty the maximum demands which will be imposed upon a line, and then not hesitate to include in their design sufficient material to insure factors of safety liberal enough to cover the normal uncertainties and variations which pertain to the materials required by the electrical nature of the line. Perhaps the ascent of voltage will stop, for a time at least, at 220 kv. and so enable designers to take breath and become familiar with the utmost demands which may be imposed on any line and to lay down values of stresses, strains and other constants which will make it possible to construct a line for any condition with a reasonable certainty that it will develop no failure due to mechanical stresses either from without or from within.

Electric Furnaces Improve the Quality of Foundry Iron

A NEW type of cast iron has been developed lately in Germany which has been used in the Brown-Boveri works in Switzerland. This iron is called pearlitic gray cast iron and is made in an electric furnace as it requires a strictly controlled chemical content and heat condition for its successful manufacture. The material is reported to have physical characteristics far superior to those found in ordinary cast iron and is cast in a hot mold.

Foundry practices and the properties of ordinary cast iron have been little changed in recent years, and yet spasmodic reports from here and there indicate a very important field of investigation for the electrical industry. The electric furnace can make better metal than any other agency, and electrical equipment could rapidly reduce the costs of handling materials in the foundry processes. No reason for the lack of better results in the electrification of foundries exists except inertia on the part of both the electrical industry and the foundrymen. More frequent "get-together" meetings, with resultant profitable discussions between the two groups, should lead to real progress in foundry development, as was proved by the recent meeting of the International Foundrymen's Association in Paris.

Clearing Ideas on a Specific Example

AT THE last convention of the Illuminating Engineering Society a novel symposium was presented under the title of "Eleven Solutions of a Street-Lighting Problem." A definite street was selected by the papers committee, and all the required data were sent out to a number of lighting specialists who agreed to furnish estimates and specifications on lighting this street. As may be expected, the submitted solutions differ widely in the expenditure and foot-candles recommended, the spacing, height of suspension and so on, but the interesting point is that all argument and discussion has thus been centered on a perfectly definite, concrete case, rather than on generalities.

This method of presentation of vital problems at engineering conventions has much to be commended in comparison to the two usual methods—a general article and a description of an actual installation. Let, for example, the subject be the electric control of steel-mill drives. Usually three or four manufacturers will contribute papers on their respective controllers, and a few operating engineers may describe their particular installations. The types of construction, the local conditions and the methods of presentation being all different, it is rather difficult for an outsider not only to come to a definite conclusion but even to form a clear, composite picture of what is what. A better way would be to select a typical steel mill and to ask a number of specialists to specify a control equipment for it, with definite reasons.

It is readily apparent that such a method of treatment is applicable to many of the subjects discussed

at conventions. Switchgear in central stations, transmission-line design, even electrification of railroads, lend themselves to analysis by example in this way. How much more useful at this time would it be for the experts to agree on the mode of traction in a specific project than to disagree on what is best for all railways under all conditions. It is to be hoped other program committees will take a hint from the experience at Lake George.

Warning of Icebergs by the Salinity of Sea Water

WHEN our Coast Guard cutters are on ice patrol duty one of the regular measurements which they make is that of the salinity of sea water. This is done in the hope that a knowledge of the salinity may help in determining shifts of sea currents and the approach of ice floes or bergs. The Bureau of Standards has recently developed a device by means of which the electrical conductivity of the sea water can be measured in a simple manner and the indications made directly in amounts of salts. This procedure is much quicker and more convenient than the usual chemical titration method.

The ELECTRICAL WORLD is glad to note this new and extremely useful application of electricity. It is not a "load" to be measured in thousands of kilowatt-hours per year, but a new service to be measured in human lives and cargoes saved.

Power-Factor Correction and Power-Factor Rates

POWER factor continues to occupy a position of increasing importance as a problem in the electric power business. It is also becoming a more complicated problem because of its size and because as systems grow the engineering problem grows at least in proportion. Yet, in the last analysis, it is recognized that it is the power factor of the individual consumer which must be improved, and that the greatest incentive to him to improve it is a rate system, with a corresponding metering system, which will make it to his benefit to take positive action. It is early apparent to any student that poor power factor is a burden on the generating company. It is not so evident to all, though it is just as definitely true, that, even without a special power-factor rate, it is also at least a detriment to the consumer. To the central-station executive the seriousness of the problem of adding equipment to meet present and future demands naturally turns his attention to means of releasing existing equipment, now devoted to the supply of useless current, to more productive work.

It is apparent, however, that comparatively little is known of what practices have been tried, both in the United States and abroad, in the way of rate systems. An investigation of the practices of some companies in this country is presented in this issue. It shows, even among companies reporting "success," that in general results have not been wholly satisfactory—and it also gives some of the reasons and some suggestions for methods which should give better results. The variety, and consequent inequality, of the various rate schedules is pointedly shown from the fact that an identical customer would have bills varying from $5,332 to $10,500 for the same load conditions on different properties. This alone at least indicates the uncertainty inhering in a search for an adequate rate clause.

The more study is made of the whole situation, the clearer becomes the conclusion that a logical rate plan must be based on a kva.-demand charge and an energy charge. This plan has both the necessary simplicity and the fundamentally correct economic basis of charging for the service rendered. It seems easily practicable to have the kva.-demand charge adequately recompense the utility for the investment charge as well as some other fixed charges and so to relate the kva. and energy rates as to care not only for actual energy consumed but also for added losses resulting from low power factor.

The universal adoption of any such system is limited largely by the non-existence of a kva.-demand meter which is practicable from the standpoint of price, reliability and accuracy. Such a meter should, and doubtless will, be produced in the near future. When it does appear it will mean a most definite step in the solving of the power-factor problem.

But a rate system and a meter, and correct and corrective customer equipment—now available to a considerable extent—will not solve the problem alone. There are still problems of customer relations, perhaps also legal problems, to be met and handled correctly as a part of the whole. And the actual engineering problem of maintaining large-system voltage regulation and load division without seriously low power factor in places is no small one. Yet no part of the solution will be of any use until a satisfactory rate and meter system is evolved.

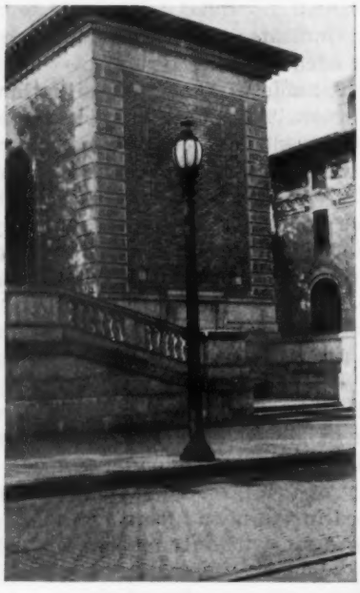
Meanwhile, the attention of executives and of their commercial and technical staffs may well be directed toward the experiences of the past and toward a closer study of the fundamentals involved in the customer-relations problem presented.

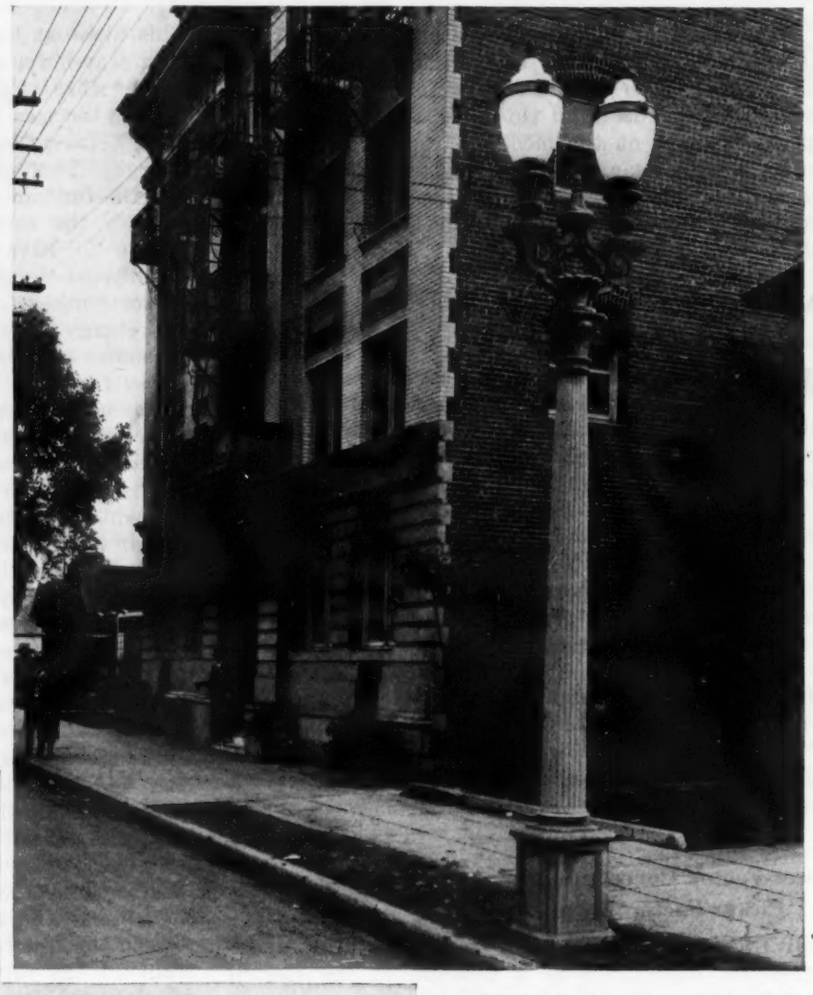
Relative Fields of Air Heaters and Economizers Investigated

AIR heaters have been available for years but received scant attention from American engineers until the recent wave of revolutionary steam practices swept the country. Then the air heater was added to the many experimental equipments installed by central-station companies, and some positive data are being obtained on the tube, plate and revolving types.

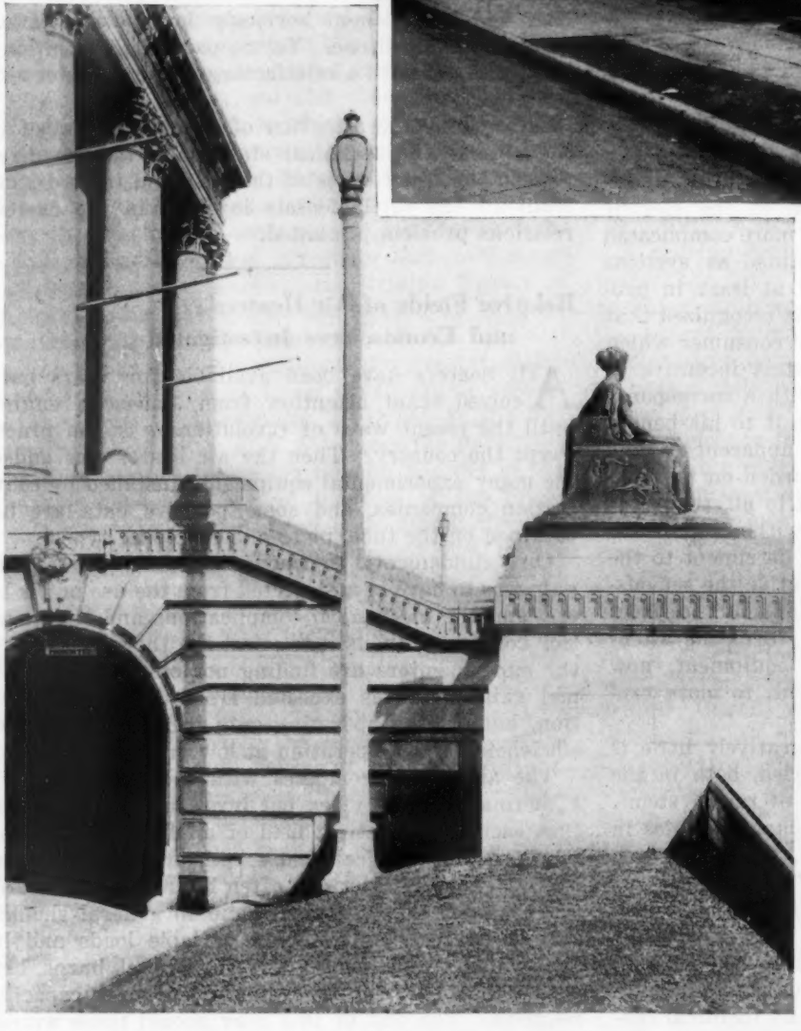
On a fundamental thermodynamic basis little thermal gain was to have been expected from the use of air heaters, and the mechanical complications and the installation costs were thought to offset the thermal gain. But the experimenters are finding not only a higher thermal gain than was expected from theoretical calculation, but also an operating gain in maintaining better efficiencies under operation at low or high ratings.

The air heater competes with the economizer from a thermal point of view, but investigation should show that each has a distinct field of application and that it may prove economical to use both under certain conditions. The air heater can often be installed to increase the efficiency of older plants and in general should be considered for plants having variable loads and high feed-water temperatures, or where fuel burns better with a warm-air supply or increased boiler capacity is required. The end of this year should make available the actual data on several installations from which preliminary reports have been promising.



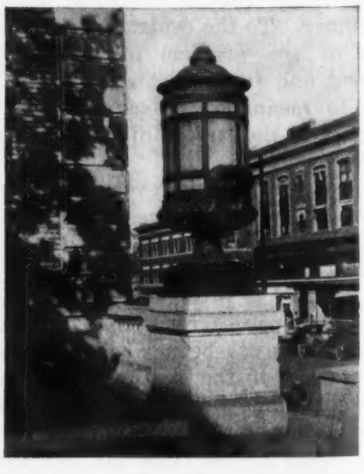


Consider Good Architecture as Well as Good Illumination



LIGHTING fixtures can be made to harmonize and blend with their architectural surroundings during the day in addition to adding greatly to the appearance of the buildings by night through the use of good illumination.

Three views from Stamford, Conn., showing well-designed fixtures attractively blending with their surroundings. A view of the tall, graceful fixtures that add to the architectural beauty of the Essex County Court House in Newark, N. J., is also shown.



Experience with Power-Factor Clauses

An Analysis of Existing Practices—Opinions of Some Who Have Tried Out Power-Factor Clauses—Administration and Operation of Typical Provisions in Existing Contracts

SOME kind of a rate clause for securing power-factor correction has been advocated by many utility executives for several years. Several of the utilities have instituted and operated power-factor rate clauses with "more or less success," and an analysis of the experiences of these utilities should be very pertinent now that the subject of power factor is receiving thoughtful consideration from both the producer and the user of electrical energy.

Admittedly the practical aspects of power-factor correction are far from satisfactory from the standpoint of either the utility or the consumer. Both have been educated to realize that the operating and investment losses resulting from poor power factors are very considerable, and both are willing to spend some money to improve the situation. But the best and most equitable method for attaining the desired results is yet to be determined.

MANY ANGLES TO THE SITUATION

Experience gained in the work of the past few years shows quite definitely that power-factor correction is profitable and practicable in many systems. But experience also shows that simply the introduction of a rate clause is not in itself the sole remedy. Much skill, study and money has had to be expended wherever a successful scheme has been instituted for the commercial accomplishment of the objectives. It has been a problem in which executives, engineers, metermen and commercial salesmen are all concerned in achieving success, and it has been found that a co-ordination of their efforts and a pooling of their thoughts were necessary to arrive at a workable plan of procedure.

The principal difficulty, of course, is that it is not a central-station problem alone. It is also a customers' problem, and customer relations are definitely involved. Before any customer is convinced that operation at poor power factor is to his disadvantage financially, both directly and indirectly, the utility must expend time and money in tests, surveys and load studies. In any given factory a conclusive study of power-factor effects requires that tests be made on machines and circuits, that a study be made of production speeds and regulation requirements, that an investigation of investment in equipment and wire be made, and sometimes even an inquiry into the cost accounting of the factory operation is necessary. And then, after real data have been assembled, the executives and engineers of the factory must be educated as to the meaning of power-factor correction, convinced that the data are correct and that remedial measures will save them money.

Even then the work is not finished, for it usually devolves upon the utility to devise ways and means for securing and maintaining power-factor correction with the least expenditure of money and time and the least complexity in operation and administration. Contracts, rate clauses, meters and meter computations, billing, operating rules for corrective equipment and flexibility to accommodate the changes that occur in factory layout or production are a few of the features to be worked out.

From the specific factory the next step is to the utility system as a whole. Power loads are to be classified as to period of peak occurrences, load and power factor characteristics. Average and peak power-factor conditions must be weighed.

Then the financial study must be made as to the cost of applying power-factor correction on the system as a whole. This involves a study of meters and meter costs, costs of corrective equipment, the size and type of load to which correction should be applied and the cost of billing and administration. There is also the question as to whether to make rate clauses applicable to all power factors or only to those below, say, 80 per cent. No universal solution can be determined nor is it to be expected that any particular rate clause will be found universally applicable. But exchange of experience is valuable at least.

In order to get the experiences of those utilities that have attempted the big task of securing improved power-factor conditions on their systems, a questionnaire was sent out by the ELECTRICAL WORLD, and the replies have been analyzed to form the basic material in this article. The magnitude of the task, as outlined in the foregoing remarks, warrants the assembly of all available experiences and their analysis for the benefit of those contemplating active efforts to improve the power-factor situation on their systems.

Some Positive Opinions

Successful operation of power-factor clauses and the reasoning back of the clauses are well illustrated in the following opinions recently received as a result of the power-factor questionnaire:

COMPANY NUMBER 1

FOR quite a period of years our rate schedules have contained power-factor clauses.

The administration and operation of our power-factor clause is left to the power sales organization. All the necessary tests to determine the power factor of the consumer's load are made by the meter department at the request and under the supervision of the power sales department. We have thought all along that this question is one which the commercial department should deal with, and it has been so handled in our organization. This policy calls for rather high-grade men in the commercial department, men who are equipped from a technical standpoint with the necessary experience and education to handle the question. They also must be of suitable personality to present the matter as a selling propostion to the consumer.

We have never considered a power-factor clause as a possible means of producing revenue. As a matter of record in our system the bonuses given to consumers having good power factor amount to far more than the penalties inflicted on other consumers having poor power factor.

Although our rate schedules provide that we meter the consumers' power factor, we have made no efforts to do so on account of the fact that simple and reliable equipment for metering the consumer's power factor does not appear as yet upon the market.

The establishment and administration of a power-factor clause is a matter of "give and take" with our consumers. We believe that the par-

ticular type of power-factor clause is of minor importance as compared with the methods and means used to administer and operate the power-factor clause. We believe that if a power-factor clause appears in a rate schedule at all, it should be enforced and should not be used merely as a talking point, forgotten after the contract is closed. Our experience, furthermore, leads us to believe that a power-factor clause should be applicable to all classes of industrial power consumers.

As to how we "sell" consumers, this perhaps can be best answered in part by stating several "don'ts." We do not refer to "penalties" for poor power factor. We do not refer to "bonuses" for good power factor. We prefer to approach the customer and show that it *costs more to serve a poor power-factor load than a good power-factor load*, and that we are willing to make an adjustment in the cost of our service for power-factor conditions. We use three methods in general: (1) Difference in the cost of our service, poor power factor versus good power factor; (2) improved service to the consumer because of good power factor rather than poor power factor; (3) improved service to other consumers on the same line because of good power factor rather than poor power factor.

Our clause for the three power-rate schedules is: The company reserves the right to test or meter the power factor of the consumer's load, and if greater than 85 per cent lagging, then the measured monthly demand shall be decreased for billing in the ratio that 85 per cent bears to the actual power factor (in per cent) as determined. The correction for all leading power factors shall be the same as for 100 per cent power factor.

If the power factor of the consumer's load is less than 75 per cent, then the regular monthly demand in kva. is increased for billing in the ratio that 75 per cent bears to the actual power factor (in per cent) as determined.

About 80 per cent of our output comes under this clause and it is identical in all three of our power schedules, each one of which is applicable to a particular class of consumers. One thing may be noted in reference to our power-factor clause. Since the measured demand is corrected for power factor, not only the billing demand changes according to power factor, but also the energy blocks, because the energy blocks are derived directly from the corrected demand. In regard to the application of the power-factor clause to types of loads and consumers, we try to treat all alike. In other words, we try to bill each consumer in accordance with the average power factor set up by his load.

As to metering:

(a) From an accuracy standpoint: You will note by referring to our rate clause that a neutral zone is provided from 75 to 80 per cent lagging. This neutral zone is intended to take up some of the possible inaccuracy in metering consumers' power factor. It also relieves us from the testing of certain loads which we know to be within a neutral zone. For other loads having power factor above and blow the neutral zone, in general we use the graphic recording power-factor meter. We are not prepared to say that this is the best method.

(b) From cost standpoint: Until the whole question of power factor is more definitely settled, we would not care to make any large investment in permanent metering equipment to be used for power-factor work.

(c) From the operating and billing standpoint:

As may be inferred, we do not attempt to meter the power factor of the consumer's load. We do, however, measure the power factor of the consumer's load by means of a graphic power-factor meter, which is installed usually for a period of from two weeks to a month. Also, it is our usual practice to install a graphic wattmeter at the same time that the power-factor meter is installed and thus secure a concurrent record of the load. From the records so obtained we calculate as accurately as possible the average power factor of the consumer's load and apply the power-factor clause to this average. As a rule, we endeavor to make at least one test of the consumer's power factor every six months. In a number of cases consumers have their own graphic power-factor meters. We have several consumers who send in their power-factor charts monthly in the same way as the power meter chart is sent in. We do not hesitate to accept the chart from the consumer's meter, except that we occasionally check his meter with our standard. We are fairly well satisfied with present methods.

We have had no difficulty in establishing power-factor clauses in our rate schedules and no legal difficulties that the writer is aware of. The power-factor clause is accepted by consumers on our system as being a fair proposition, and with very few exceptions we have no complaints regarding it.

A rather striking case of trouble occurred in a large foundry and machine company whose power factor when measured was found to be about 65 per cent lagging. This was rather surprising to every one concerned as the company operated several synchronous motors. Investigation disclosed the fact that the synchronous motors were being operated at very much reduced excitation, and instead of being high-power-factor machines they were actually operating at a power factor worse than the majority of induction motors. When properly excited, there was no difficulty in raising the power factor of the consumer's load to 95 per cent, with a resulting improvement in the voltage regulation at the plant. In addition, the consumer was given an adjustment in his power bills which amounted to over a thousand dollars a year.

This case brings out a particular point which has not been given the attention which it deserves. At the present time, only one large manufacturer of synchronous machinery stamps on the nameplate data giving the excitation required by his machine for 100 per cent or 80 per cent leading power factor as the case may be for the particular machine.

The manufacturers of synchronous motors should stamp this information on the nameplate of the machine.

COMPANY NUMBER II

OUR power-factor clause has proved satisfactory as a revenue producer or an incentive for the consumer to improve his power-factor conditions and has been very simple from a metering and billing standpoint, and we can suggest no improvement.

We have no additional organization for the administration and operation of the power-factor clause, since our ordinary organization for power work takes care of this. Whenever we determine that a consumer has a low power factor, we take the matter up with him, calling his attention to the penalty, and suggest that we shall be glad to be of assistance in a study of corrective possibilities. If the customer is satisfied to have a low power factor and pay us therefor, we have no objections, and since we can provide synchronous equipment in our substations to take care of the low power factor as long as we are securing sufficient revenue to cover the cost of the service, including interest, we are not particularly interested in the consumer's power factor.

We have no results showing a definite power factor due to the power-factor clause, because our business is growing too rapidly to make any comparison, but about 85 per cent of our power business is taken care of under the rate with the power-factor clause.

In installations of 200 kw. and over we meter the demand and the power factor monthly by active and reactive printometer meters, and we find this metering equipment the most expensive but the most accurate. For installations of 300 kw. to 2,000 kw. we usually install a General Electric G-4 demand meter and a kilowatt-hour and a reactive meter, and thereby secure the average power factor. For installations of less than 300 kw. we usually use the General Electric M-4 demand meter and measure the average power factor. We have found the average power factor to be an equitable method of measurement for low-tension metering, but not for high-tension metering, and in those cases where the service is metered at high tension the printometer type meter should be used.

We have a customer who has an actual demand of about 1,000 kw. and an average power factor of about 50 per cent, which means that the billing factor is about 1,400 kw., or $500 a month penalty for low power factor. The consumer is an excellent prospect for heat-treating load, and we have recommended that he shall not install a synchronous condenser, but instead about 300 kw. of heat-treating equipmet. It so happens that the consumer's billing demand will not be appreciably affected, and we shall secure the additional load which he can well afford to put on.

Our specific clause for general power customers provides that if the average power factor is more than 85 per cent, the demand for billing purposes will be adjusted to an 85 per cent basis. If the power factor is less than 80 per cent at the time of maximum demand, or 70 per cent average, the demand for billing purposes is adjusted to 85 per cent.

COMPANY NUMBER III

WE ARE still groping our way to find the best solution. It seems to be very difficult to apply a general power-factor clause which works out satisfactorily in all cases.

It is not our object to provide additional revenue. We feel that in every case the customer can—either by the selection of the proper motor or by means of corrective apparatus—furnish

a power factor of at least 80 per cent under average conditions.

We find that by means of a power factor clause such as our later contracts contain the customers also find it advisable to correct the power factor rather than pay any penalty for low-power-factor condition.

The application of a power-factor clause for the first time proves a source of difficulty with the customers. It requires considerable explanation and attention. We have made it a practice in a large number of cases to make a complete survey of the customer's motor installation in order to determine for the customer what changes are desirable to improve power-factor conditions. This we have done without any expense to the customer, and it has proved of great value both to him and to ourselves.

The best application of a power-factor clause is by means of a demand and energy charge rate, the demand to be measured in kva. rather than in kw.

We have not provided a special organization for administration of pow r-factor clause, but have called upon our metering department for test work and demonstration.

At the present time about 35 per cent or 40 per cent of our connected capacity comes under the power-factor-clause rate.

From the standpoint of accuracy we find measurement of power factor by means of comparison of two watt-hour meters, one measuring reactive kva. and the other one kw., to give us highly satisfactory results, and the same is true from a cost standpoint.

Where the power-factor clause is applied on the basis of power-factor conditions of the entire month, the methods above given also are best. Where it is necessary, however, to confine attention to power-factor conditions to predetermined intervals of the day the graphic representation of power factor is the better scheme. This is true for the reason that if watt-hour meters are employed, it is necessary that they in turn operate a graphic device, so that it is possible for the billing department to determine the power factor during such predetermined periods of time.

We have no actual data on improvements obtained, but in a number of instances there has been great improvement in voltage conditions by the customer correcting power factor by means of using spare capacity in its own generating apparatus.

Our clause is as follows:

"The consumer agrees that it will at all times between 7 a.m. and 6 p.m. on week-days maintain a power factor of 80 per cent or better. In case tests made by the power company shall indicate that the consumer's power factor is lower than 80 per cent at any time between the hours of 7 a.m. and 6 p.m., the consumer shall make the necessary changes in or additions to its equipment to correct the fault, and during each month until such change is made both the demand and kilowatt-hour charge for each month shall be increased by the following percentages for the following power factors as shown by tests:

Per Cent Increase	Power Factor, Per Cent
5	Above 75 and not above 80
15	Above 60 and not above 70
25	Above 50 and not above 60
50	50 or less

COMPANY NUMBER IV

THROUGH careful study, adequate missionary work and the co-operation of customers we have incorporated a power-factor clause in our rates which has proved successful from every standpoint. At present 82.7 per cent of our output comes under the power-factor clause, and on peak load the power factor of the system ranges from 88 to 91 per cent lagging.

We have been able to show customers that the saving in power cost by installing corrective equipment is sufficient to pay 25 to 50 per cent return on the investment. The clause has worked out successfully as a revenue producer, as a practical metering proposition by using active and reactive meters, as a feasible accounting and billing system, and as regards its reaction on customer relations.

The administration and operation of the clause is in the hands of the distribution and power engineers. The rate is applied in two ways:

For general power with incidental lighting with a demand under 15 per cent of total demand the bill is decreased by 1 per cent for each 1 per cent the average power factor is above, or increased by one-half of 1 per cent for each 1 per cent the average power factor is below, the following: 75 per cent for installations of 75 hp. or less, 85 per cent for installations of over 75 hp.

The power factor is determined under this rate as follows: Installations of 75 hp. or less, by measurements periodically (at least once in each six months), or, upon payment of $2 per month, the customer may have power factor determined in the same manner as for installations of over 75 hp., i.e., by computation monthly from the registrations of active and reactive watt-hour meters.

For general power having a high load factor the measured demand is decreased or increased proportionately for billing purposes if the average power factor is above or below the following: 75 per cent for installations with a demand of 50 kw. or less, 85 per cent for installations with a demand of over 50 kw.

COMPANY NUMBER V

OUR power-factor clause is incorporated as part of the general demand billing as follows:

"The average load will be determined for each half-hour period by suitable instruments. Either the average kilowatts or 80 per cent of the average kilovolt-amperes, whichever is highest, will be considered the demand for that period. The average of the 150 highest demands that have occurred in the year preceding the date to which the bill is rendered will be the kilowatts of service for that bill."

The power factor of retail customers' load under 60 kva. has not yet been considered. Results of this clause are very satisfactory from all standpoints.

Low power factor at the private plants requires increased generating capacity. Rates should be only on a competitive basis; therefore, the capacity or demand charge equivalent to overhead on plant should be made on a kva. basis. If rates are irrespective of locality, the copper losses due to low power factor should be overlooked, as are the regular transmission losses.

Power factor does not appear on the customer's bill. In case of complaint, competition or very low power factor, the regular power salesmen investigate each individual case, reducing the connected motor load if possible. Few cases have so low a power factor that condensers will show a profit. Although we sell capacity in kva., we always try to influence the customer against overmotoring.

COMPANY NUMBER VI

WE HAVE had a power-factor clause in operation for over a year with splendid results. The introduction of the clause has raised our system power factor from about 70 per cent to 85 per cent, and about 25 per cent of our total sales for light and power come under the clause. These loads maintain about 100 per cent power factor.

A power-factor clause is only practicable, in our judgment, in the case of large consumers with a demand in excess of 500 kw. The following clause is used by us:

"A deduction or addition of 1 per cent of the bill for each 1 per cent that the monthly average power factor is in excess of or less than 85 per cent.

This applies only to purchasers buying power metered at 13,200 volts and who supply their own transformers and substation quipment.

The power factor is determined by the readings of a reactive volt-ampere-hour meter, the data are taken by our regular meter readers, and billing is done by our usual force. We talk this clause to customers from the standpoint of real reduction in cost of power and usually find the large customer has an engineering staff capable of comprehending the mutual advantages of high power factor.

Some Negative Opinions

Representative opinions of companies which disbelieve in power-factor clauses or have had little success in putting them into operation are as follows:

COMPANY NUMBER VII

WE FEEL that under present conditions on our system it is not advisable to establish power-factor clauses. It would work to the advantage of a few consumers, but in cases where penalties are assessed, dissatisfaction arises.

COMPANY NUMBER VIII

WE HAVE considered this matter at considerable length and, although in one or two cases we have undertaken to include power-factor clauses they have been taken out of the contracts before the contracts were closed.

We are doing a good deal toward the matter of power-factor correction, but it is mostly done in our own substations with synchronous condensers. We have found it difficult to explain to our customers what we mean by power-factor correction, and they generally take the attitude that they are in the market for power and prefer us to handle the technical parts of the question. In one or two cases we have been able to get

customers to install condensers, explaining to them that it has a value to them in the matter of voltage regulation and in reducing the transformer capacity necessary in their substations, but this has been the exception rather than the rule.

COMPANY NUMBER IX

WE HAVE never put any power-factor clause into practice. While we have given the matter some thought, we do not believe that anything of this nature would help us much in the present stage of development in our territory.

The only place that low power factor affects us much is in the distribution system and substation transformers, inasmuch as on account of the fact that our long lines supply a very considerable amount of leading current in the shape of charging current the power factor at our generating stations is quite high. While low power factor is sometimes a problem on the distribution system, we have not found as a practical matter that we could better the situation with a power-factor clause in our rates.

COMPANY NUMBER X

WE HAVE a clause in our tariff which requires a minimum power factor of 80 per cent on the part of any customer purchasing electric service, but we have found no way in which to make this clause actually operative inasmuch as we have no particular rate, discount or inducement to offer the consumer which would induce him to install synchronous motors or other equipment to improve power-factor conditions.

Some companies have adopted the kva. power rates, which in a manner encourages the use of high-power-factor apparatus, but in my opinion as long as the manufacturers sell and encourage the sale of squirrel-cage induction motors of all sizes, and as long as these motors are sold considerably cheaper than synchronous motors of the same sizes, it will be impossible to improve power-factor conditions unless the utilities see fit to make a lower rate for energy to consumers maintaining high-power-factor loads.

It might be possible for utilities having no competition to fix rules and regulations with public service commissions' approval which would tend to force the use of high-power-factor apparatus. My opinion is, however, that this is not a desirable way to bring about the result, which should be accomplished by a campaign of education and some inducement in rate.

COMPANY NO. XI

WE HAVE no power-factor clauses embodied in our rate clauses, although we have made studies at various times to determine the advisability of including such clauses in our rates. But our system consists of very long transmission lines, and the resultant capacity offsets the inductive effects of motor loads to a certain extent and our system power factor is very satisfactory.

We realize that we are being penalized for excessive investment in local distribution and transformer equipment to service low-power-factor customers, but we believe the possible revenues through rate penalties would not offset the expense of administering the clauses and carrying the added meter investment, to say nothing of resulting dissatisfaction, complaints and loss of good will.

GROPING FOR A SOLUTION

Eight companies out of twenty-four to which questionnaires were sent stated they were much interested in power-factor correction and were studying to arrive at some workable and adequate scheme for introduction on their system. Several things give trouble in connection with the introduction of a system. The cost of meters and administration is excessive if applied to all power loads, and the meters available are not entirely satisfactory from an administration standpoint. The introduction of a power-factor-rate clause complicates the rate schedule, is difficult to "sell" to the consumer, is difficult to compute and incorporate in a billing scheme, and is difficult to apply in such a way as to treat all customers equitably.

Yet the visible advantages of good power-factor conditions for both the producer and the consumer are so enticing that these companies believe some corrective scheme should be instituted.

MANY RATE CLAUSES ARE AVAILABLE

The power-factor clauses that appear on rate schedules are not always enforced. Only eighteen of the twenty-four companies recently canvassed enforce their clauses. Many of the clauses are vague and indefinite and are used as a threat when making power contracts and then are laid away in lavender. Of the enforced clauses, a great non-uniformity exists as to basis of billing and application. A study of the table shows the application of the clauses of nineteen different systems to a hypothetical power customer who has the same demand and energy rates for all the systems. Six give an inducement of small value to improve the power factor above 80 per cent. All nineteen penalize low power factors with 80, 75 and 70, as basic starting power factors for penalty applications, depending on the company. A very remarkable difference exists in charges. For 70 per cent the difference between the lowest and the highest bill is $1,650, while for 50 per cent power factor this difference becomes $5,168, which is about equal to the total power bill at unity power factor. Some of the clauses are inequitable and ill-advised and only a very few have any logical basis. A general trend exists toward the use of a clause that involves the use of demand billing on a kva. basis with a bonus and penalty for power factors above and below a specified figure. But a wide difference of opinion exists as to how much bonus or penalty to apply.

The following are typical rates applied by utilities to secure power-factor correction:

1. Bill 80 per cent of the kva. demand instead of kw., if the power factor goes below 80 per cent for a material length of time.

2. When the actual power factor is less than 80 per cent, the demand to be charged and paid for shall be obtained by multiplying the demand shown by the meter at the time of measurement by 80 and dividing this product by the actual power factor.

3. Should in any one month the power factor be less than 75 per cent, the gross service charge will be increased for that month at the rate of 5 cents per kilowatt of demand for each per cent that the power factor is less than 75 per cent.

4. If the power factor is found to average below 85 per cent, 1 per cent shall be added to the contract demand charge for each 1 per cent of average power factor below 85 per cent.

5. When graphic instruments are used for measurement, the contract load is determined by dividing the reading by 9/10; this is on the assumption that the power factor is 80 per cent and we are dividing with the customer the burden of the power factor. Smaller power customers taking less than 100 per cent kw. have their demand measured by Wright demand indicators, in which case we multiply the demand meter reading by 9/10, thus again dividing power factor burden with the customer.

6.

Power Factor (Per Cent) of Customer's Load	Per Cent Increase in Service Charge
75 to 79	7½
71 to 75	15
61 to 70	30
51 to 60	60
50 and below	100

7. For each reduction of ten points in the ratio of reactive kilovolt-ampere-hours to kilowatt-hours for any given month a discount will be allowed on the gross bill computed at the rate of 1 per cent for each such ten points decrease. (Maximum discount 8.72 per cent.) For each increase of ten points in this ratio a corresponding charge will be added to the gross bill computed at the rate of 1 per cent for each ten points increase.

8. The minimum power factor when operating the consumer's normal loads shall not be less than the following: Up to 10 hp., 80 per cent; 10 hp. to 100 hp., 85 per cent; in excess of 100 hp., 90 per cent.

The company may test once in each six months to determine the average power factor under normal operating

conditions, and if the power factor is below the minimum, then the rate for energy metered at 2,200 volts for the month in which the test is made and for succeeding months until another test is made shall be increased for billing purposes in accordance with the following formula:

$$\frac{\text{Schedule rate times required power factor}}{\text{Average power factor in per cent}} = \text{billing rate}$$

9. If the power factor from test is more than 85 per cent lagging, then the measured monthly demand shall be decreased for billing purposes in the ratio that 85 bears to the actual power factor. If the power factor is less than 75 per cent lagging, then the demand for billing is increased in the ratio 75 bears to the actual power factor.

10. If power factor from test is less than 80 per cent, then the demand and energy charges shall be increased as follows:

Per Cent Increase	Power Factor
5	Above 70 and not above 80
15	Above 60 and not above 70
25	Above 50 and not above 60
50	50 per cent or less

Clause No. 2 is the most popular, six systems using it as compared with four systems using clause No. 1. Clause No. 2 is used by one company with the addition of a bonus which is based on the same percentage basis as the penalty. Clause No. 4 is also used with a bonus system, one company granting 1 per cent decrease in bill for each 1 per cent increase in power factor above 85 per cent and another reducing the bill one-half of 1 per cent for each 1 per cent increase in power factor above 85 per cent. The clauses of the type given in No. 1 and No. 2 are favored because they are easy to operate and administer with an existing organization and commercial metering equipment is available for determining kva. demand. This type of clause also is favored because the block energy rates can be related to the demand values, and in this way a convenient method is available to secure both a demand and energy charge for poor-power-factor conditions.

ADMINISTRATION OF CLAUSES

The consensus of opinion is to the effect that the responsibility for the application and enforcement of power-factor correction should be by the power sales department. This is because the many elements involving public relations, customer relations, engineering studies and tests and unusual metering and operating procedure can best be treated by the high-grade commercial and engineering type of personnel found in modern power sales organizations.

Power-factor correction is but one added duty for the consulting service engineers commonly called power salesmen. These men can call upon and supervise the more technical work of the engineering, testing and meter departments when their services are needed and can speak with perspective and knowledge in councils involving the utility executives and ratemakers.

When the magnitude of the engineering and commercial job involved in a real study of corrective possibilities is considered, it is no wonder that hit-or-miss methods have often failed and are entirely illogical. The only practicable way to carry out a power-factor analysis is on a piecemeal and step-by-step basis, and even this is subject to question on account of the system changes that may occur because of the long-time element involved. Yet, once a system is analyzed and known, conditions can be kept up to date quite readily since each new customer can be treated as he comes on.

CONCLUSIONS

Some general conclusions to be drawn from past experiences are:

1. Rates should be simple and power-factor correction should be handled without attempting to educate customers as to the meaning of power factor and without specific mention of power factor in the rate clauses.

2. Equipment and methods have been developed whereby it has been found feasible and profitable to apply power-factor correction to large power customers.

3. In order to secure the simplest rate system, customers should be billed on kva. demand and on energy consumption. The greatest drawback to this scheme lies in the inadequacy and cost of kva. metering equipment, and the greatest constructive step toward the adoption of this rate scheme for all customers lies in the development of a kva. demand meter which ranks with a kw.-hr. meter in accuracy, cost and simplicity.

4. Less than a dozen central-station companies really enforce a power-factor-rate clause, and there is a decided disagreement as to the best type of clause to use. Yet executive attention and interest in the question of power-factor correction have never been greater, and the future looks promising.

5. A really workable scheme for improving the power factor of systems will save millions of dollars to the industry through eliminating the necessity for adding capacity to care for increasing loads and through increasing the production and bettering the service of power users.

6. The solution to the power-factor situation involves the use of higher-power-factor equipment, the use of corrective apparatus by both the central station and the user and the adoption of a rate system involving both a capacity and an energy charge.

APPLICATION OF POWER FACTOR CLAUSES IN MONTHLY BILL

Assumed conditions: 500 kw. maximum demand, 150,000 kw.-hr. per month, demand rate $1.50 per kw., energy rate 3 cents per kilowatt-hour and power factors of 50 and 70 per cent lagging and unity.

50 per Cent	70 per Cent	100 per Cent
$6,375.00	$5,302.50	$5,137.50
5,696.00	5,302.50	4,787.00
6,000.00	5,572.00	5,250.00
7,085.00	5,600.00	4,900.00
6,000.00	5,572.00	5,138.00
5,550.00	5,360.00	5,138.00
7,875.00	6,040.00	5,250.00
10,500.00	6,925.00	5,250.00
5,875.00	5,275.00	5,250.00
6,000.00	5,572.00	5,250.00
5,435.00	5,362.00	5,250.00
5,332.00	5,332.00	5,250.00
5,700.00	5,575.00	5,250.00
7,875.00	5,860.00	5,250.00
5,700.00	5,405.00	5,250.00
5,700.00	5,360.00	5,250.00
5,700.00	5,572.00	5,250.00
6,195.00	5,813.00	4,465.00
9,450.00	6,760.00	5,250.00

Model Cotton Mill in China

ONE of the most up-to-date cotton mills in the world was recently put in operation at Shih Kia Chwang, Chihli, China, by the Dah Shing Cotton Spinning & Weaving Company, all the equipment being of Westinghouse manufacture. Power for the plant is furnished by a 1,250-kva. turbo-generator unit which supplies current at three phase, 60 cycles and 600 volts. The switchboard is of standard construction and includes the latest protective devices. Motor drive is used exclusively. There is plenty of coal available near the mill, but good water is scarce and it is necessary to conserve the supply. To do this a spray system and cooling pond have been installed.

Is the Overhead Ground Wire Effective?

BY C. C. MOLER

With Comments by F. W. Peek, Jr.

THERE has been a wide variance of opinion and much discussion regarding the performance and protective value of the overhead ground wire on transmission lines. Several years ago the National Electric Light Association made a study of this subject, sending out questionnaires to about sixty of the leading transmission companies. The questions covered the subject very thoroughly and the replies* ranged from one extreme to the other. Some were based on experience and comparative data, while others were opinions more or less unsupported. The net results, however, were such that no conclusions could be drawn.

Dr. Steinmetz has expressed himself rather definitely in this regard. He supports his opinion by an explanation of the performance of the ground wire, and says that if in operating a transmission system he were deprived of one or the other—the overhead ground wire or the lightning arrester—he would prefer to retain the overhead ground wire. A study of this subject requires a great deal of time and apparatus, whether made in the laboratory or in the field.

The writer has developed a theory which he wishes to present for discussion: The earth is a conductor of varying conductivity, depending upon the place, conditions, seasons, etc. Nevertheless, it is one conductor, and no part of it can be considered as insulated from another. It is often said to be at zero or ground potential, and therefore a difference of potential can exist betwen two points only until the resulting ground current has dissipated or equalized this difference in potential. A discharge of lightning between a cloud and a point on the earth raises that point to a high potential. This potential is dissipated by high-frequency surges through the earth in all directions, probably with the greatest intensity comparatively near the surface. These ground surges themselves set up surges in neighboring transmission systems.

Consider a transmission line 50 miles in length paralleled by an overhead ground wire grounded every 500 ft. and supported only a few feet from the transmission-line conductors. A stroke of lightning taking place near one end of the line—not necessarily a direct stroke on the line—tends to dissipate itself through the earth to more distant points, including territory at the far end of the line. The earth offers some resistance, and therefore at least a part of the discharge finds a convenient path through the overhead ground wire. It reaches the ground wire through many of the neighboring grounds and then takes its course over the ground wire, dissipating itself by returning to the earth through many of the grounds that are near the far end of the line.

These surges taking place through the overhead ground wire only a few feet from the line conductors induce heavier surges in the transmission system than if the lightning discharge had been through the ground only, which discharge, if it did parallel the line, would have been much further from it. Stray trolley currents take overhead ground wires in their return paths. This is proved by the grounds being eaten off by the electrolytic action. As a better example, however, lightning has often been seen to snap at the joints in railroad rails when the storm was miles away. These rails are well grounded at places and grounded to some extent throughout. Similar occurrences have been observed on pipe lines which were actually covered with earth throughout a large part of their length. Therefore there can be little doubt that these manifestations are parts of the original lightning charge and not induced currents.

If this theory be correct, would it not be better to adhere closer to the lightning-rod idea, stringing overhead ground wires, but breaking them up into as many sections as there are grounds by inserting strain insulators? This method would, of course, entirely destroy what has been put forth by some engineers as the action by which the ground wire prevents or reduces surges in the transmission conductors, i.e., its inductive relationship to them. However, is this not looking at the problem as through the wrong end of a telescope? Why not consider the surges existing primarily in the ground wire, thereby inducing surges in the conductors.

VIEWS OF F. W. PEEK, JR.

In commenting upon this theory at the request of the editors of the ELECTRICAL WORLD, F. W. Peek, Jr., said:

"If I understand the author correctly, he believes that during a thunderstorm a difference of potential between points on the ground along a transmission line may cause large transient currents to flow in the ground wire, and that such currents by magnetic induction would cause transients in the transmission line. I doubt very much if appreciable transient currents ever flow in the ground wire owing to the above cause. The earth itself would offer a much easier means of equalization for such currents. Even when two earth points are miles apart, the greater part of the resistance is usually in the contact. Thus, even if the resistance of the wire were low and it did not have a high inductance to earth the contact resistance would still prevent large transient currents from following it.

"However, current does flow in the ground wire during its operation as will appear. The ground wire offers protection (1) by acting as a lightning rod in case of direct stroke, (2) by reducing the voltage induced by electrostatic induction.

"The induced voltages are determined by the 'charge' on the line and by the capacity of line to ground. When a lightning flash occurs from cloud to cloud or from cloud to ground, the charge on the line is released and a wave of voltage and current results. The voltage above ground will be low if the charge is small and the capacity to ground large. The ground wire reduces the voltage by reducing the charge on the transmission line below that on an unprotected line and by increasing the capacity between line and ground. Calculations indicate a reduction of 30 per cent or more.

"In either case (1) or case (2) a current will flow in the ground wire by direct stroke or static induction, but will discharge to ground at the nearest grounded point. Current flowing in the ground wire will, of course, cause current to flow in the transmission line by electromagnetic induction. This will, however, be small compared with the current directly induced in the line.

"Electromagnetic induction may be of importance in certain special cases. For instance, a magazine protected by a complete cage would be free from electrostatic induction, but heavy lightning currents flowing in a lightning rod could produce voltage in the interior of the cage by electromagnetic induction."

*N. E. L. A. Proceedings, 1921, Vol. 2.

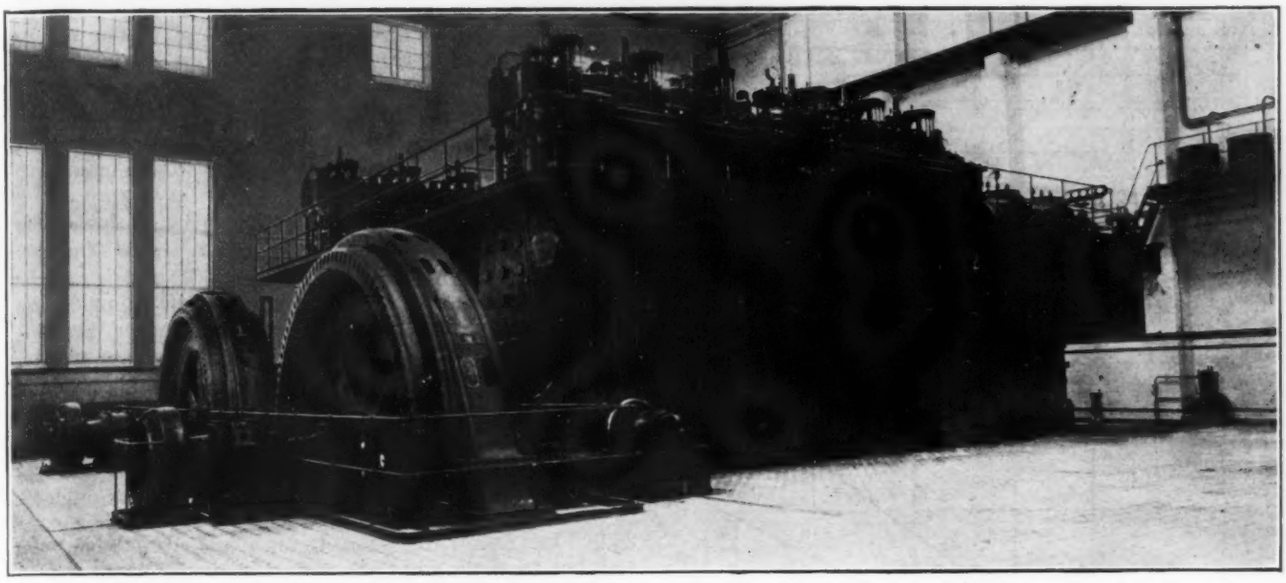


FIG. 1—TWO 3,000-HP. TWO-CYCLE DIESELS IN BREMEN ELECTRIC PLANT

Possibilities of Diesel Engines for Central-Station Service

This Equipment Can Be Built in Large Sizes, Despite Assumption to the Contrary—Erroneous Conception Prevails as to Its Costs and Limitations—Analyses of Cost of 5,000-Kw. and 20,000-Kw. Stations

By E. B. POLLISTER
Busch-Sulzer Brothers-Diesel Engine Company

THE rapidly changing art of energy production has revived the interest in possible alterations of many pieces of equipment and schemes of development that had been considered as fixed and stationary. The object of all efforts in this direction is to produce electricity more cheaply whatever the type of equipment used.

The use of high-pressure steam and of mercury-vapor boilers and other radical departures have caused Mr. Pollister to write this article on the Diesel engine, with the idea that central-station engineers and executives should carefully consider this type of prime mover in the larger sizes that can be built on the basis of years of actual experience with smaller units.—*Editors.*

FRANKLY speaking, central-station engineers and executives have been conservatively slow in using the Diesel engine and have not sufficiently investigated its possibility as a prime mover in the central-station industry. They have been inclined to assume without much investigation that the admittedly superior thermal economy of a Diesel engine is offset by a higher initial cost, a higher maintenance cost, a shorter life, and a more expensive, because more skilled, operating force. They have, besides, too quickly decided that its use is properly limited to small units under 1,000 b.hp. in very small stations.

These assumptions about the Diesel are incorrect, and its possibilities should receive thorough and careful consideration. In the first place the Diesel engine has a thermal efficiency such that 30 to 35 per cent of the heat units in the fuel are converted into mechanical energy. Moreover, if the available heat in the exhaust gases and cooling water is fully utilized in waste-heat boilers or exhaust-gas turbines, an over-all Diesel plant thermal efficiency of 80 per cent may be obtained.

This is an outstanding figure to contemplate in comparison with the possible thermal efficiencies of any steam or mercury-vapor plant, and yet the inherent engineering difficulties and mechanical complexities associated with its attainment are less than those encountered in any other energy-conversion system. It seems remarkable that such an economical thermal agency has been left quiescent by central-station engineers during the recent period of searching the highways and byways of the world for equipment capable of being developed into more efficient thermal mechanisms.

It may be that this has resulted from the assumption that Diesel engines can be built in small sizes only or in small quantities. As an actual fact, however, in Europe one manufacturer, as an example, has built 750,000 hp. in Diesel engines since 1903 in sizes up to 4,000 b.hp. and including 39-b.hp. to 1,500-b.hp. units and has suc-

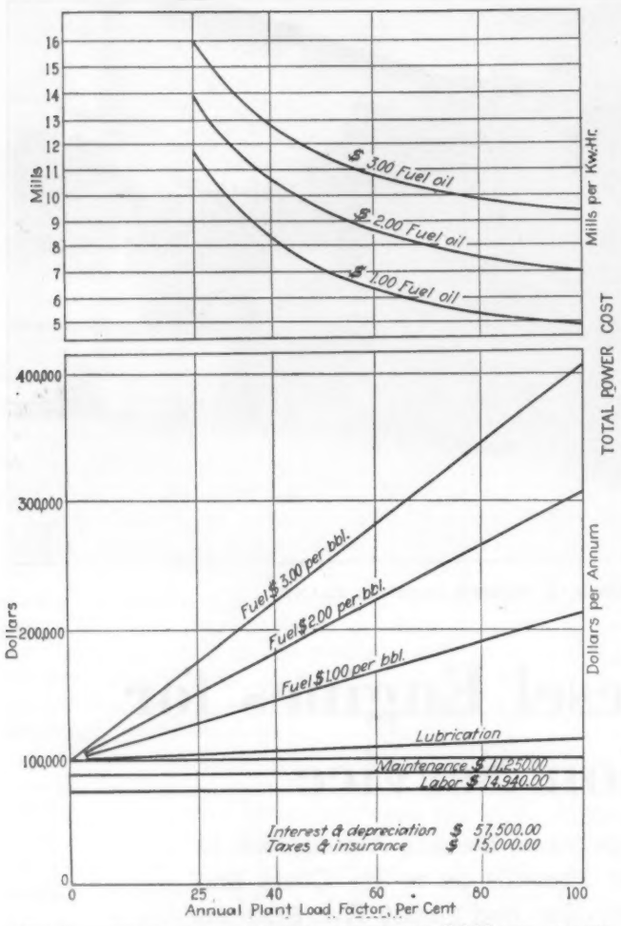


FIG. 2—COST OF DIESEL-ENGINE POWER FOR 5,000-KW. PLANT

cessfully constructed a 2,000-hp. experimental cylinder to demonstrate the practicability of eight-cylinder, 10,000-kw. units. Yet the total stationary Diesel capacity in the United States in central-station service will not aggregate more than 500,000 b.hp.

There is no reason whatever to state didactically that Diesel-engine units are limited to small sizes. There is no engineering reason why 4,000-kw. and 6,000-kw. units cannot be produced in this country at present, and there is little difficulty in visualizing units of 10,000 kw. and 15,000 kw. as a future development. And why shouldn't 4,000-kw. or 6,000-kw. Diesel-engine units be used in the central-station industry, even with the development of superpower systems?

A 20,000-kw. Diesel plant will use only 0.75 sq.ft. of floor space per kilowatt installed, or a room about 168 ft. x 94 ft., having a height of 46 ft., including crane clearances. It will cost complete about $150 per kilowatt installed and will contain five 4,000-kw. units. If it operates at a 50 per cent load factor, the fixed charges on the initial cost will not exceed 1 mill per kilowatt-hour. The life of the engine will be at least twenty-five years, the depreciation rate being only about 4 per cent and the maintenance 1½ per cent.

OIL-BURNING STATIONS SHOULD CONSIDER DIESELS

The United States Department of the Interior reports an annual consumption of fuel oil in the production of electricity of 13,197,216 barrels for the year 1922. Of this amount about 12,000,000 barrels was used in steam boilers in generating stations in all parts of the country. Rhode Island, Kansas, California, Texas and Florida are states that use large amounts of fuel oil under steam boilers. Operating records of the largest stations show a consumption of 1.2 lb. per kilowatt-hour. At an assumed cost of $1.50 per barrel and a fuel consumption ratio of one to two, the saving which could be effected by burning this oil in Diesel engines would mount to $9,000,000 per year.

Where fuel oil competes with coal for boiler fuel, both conservation and economy show that Diesel engines have great possibilities.

Where coal is of poor quality or high in price, or where load conditions, such as standby service, are unfavorable to the economical operation of steam plants, the reduction in the cost of fuel through the use of Diesels is at once apparent. In the issue of June 2, 1923, the ELECTRICAL WORLD published a table showing the operating economies and production expenses of forty-five coal-burning stations, from which a list of twelve plants, with capacity ranging from 10,000 kw. to 25,000 kw. and with relatively high fuel costs, have been selected to show what the reduction in fuel cost would be if Diesels were used.

On the basis of two-dollar fuel oil averaging only 10.6 kw.-hr. per gallon, Diesel engines with an equivalent fuel cost of 4.5 mills would generate the total output of these twelve stations for one year with a fuel bill $1,433,304 less than the cost of the coal actually used. These twelve plants cover wide ranges in fuel cost, fuel quality, load factors and type of equipment, and it is not claimed that Diesel engines should replace the steam equipment in all of the plants. But the Diesel engine should be carefully considered for all of them, and not only with reference to its high fuel economy.

The cost of Diesel power, like that of steam power, will vary with the cost of fuel, requiring from 2 mills to 6 mills per kilowatt-hour with oil costing respectively $1 and $3 per barrel. The comparative cost of coal and oil, therefore, is a very important factor in the selection of the type of prime mover, but there are other factors which may warrant the use of Diesels even where the cost of fuel oil is high in comparison with the cost of coal.

COMPUTING FIXED CHARGES CORRECTLY

Because of its higher initial cost the Diesel has been too generally condemned without a hearing—guilty of high fixed charges. And yet, in comparison with steam

TABLE I—COST OF PLANT, 5,000-KW. DIESEL CENTRAL STATION

	Total	Per Kw.
Real Estate—Lot 175 ft. x 200 ft.	$2,000	$0.40
Building—Brick, 112 ft. x 60 ft. x 24 ft. including 5-ton cranes and 7,500 bbl. concrete fuel-oil storage	65,000	13.00
Foundations—For engines and generators, 1,400 cu.yd., at $15	21,000	4.20
Diesel Engines—Five, each rated at 1,000 kw.; total weight, including standard auxiliary equipment, about 840 tons; f.o.b. factory	550,000	10.00
Generators—Five, each rated at 1,000 kw., three-phase, 60-cycle, 2,300 volts, including direct-connected exciters, weight about 90 tons, f.o.b. factory	50,000	10.00
Freight—On 930 tons, at, say, 75 cents per 100 lb. (engines and generators)	14,000	2.80
Piping—70 ft. of 12-in. exhaust piping per engine; small oil and water piping to connect engines to oil tanks and water supply	8,000	1.60
Cooling-Water Equipment—Including tower, motor-driven pumps and piping	10,000	2.00
Erection of Machinery—Including superintendence, expert and common labor	10,000	2.00
Switchboard—Eight panels, including station wiring, installed	10,000	2.00
Miscellaneous Items and Contingencies	10,000	2.00
Total	$750,000	$150.00

turbines of any size, the obsolescence factor in depreciation is almost nil and the depreciation rate very low. No appreciable improvement in Diesel fuel economy has been made in the last twenty-five years, and the future economy lies in the direction of utilizing accessory equipment, such as waste-heat boilers, rather than in the engine itself.

A high-grade Diesel, when properly maintained, will last indefinitely. The very nature of its construction and the materials used prohibit physical depreciation, and only proper maintenance is required to secure and keep its initial test bed economy. Diesels were first built on a commercial scale in this country about 1904, and records of these early designs show that:

1. Nine out of a total of eleven Diesels rated larger than 100 b.hp. built in 1904 are in service today. Of these four are operated by the Texas Power & Light Company.

2. In central stations today there are five Diesels operating in their twentieth year or longer, fifteen Diesels operating in their nineteenth year, twenty-six in their eighteenth, forty-two in their seventeenth, forty-seven in their sixteenth and fifty-one in their fifteenth year or longer.

3. Of the Diesel horsepower sold to central stations from 1903 to 1910 inclusive, 93 per cent is still in service, giving approximately the same economy as the Diesel built today.

From the evidence submitted it can be stated conservatively that the useful life of a Diesel engine is at least twenty-five years.

Estimated Cost of 5,000-Kw. Diesel Plant

A 5,000-kw. Diesel-engine generating station may be installed today at a cost of approximately $150 per kilowatt, a total investment of $750,000 (Table I). On the basis of a twenty-five-year life the depreciation is

TABLE II—OPERATING COSTS, 5,000-KW. DIESEL CENTRAL STATION

Total Fixed Expense per Annum:		
Interest and depreciation	$57,300.00	
Taxes and insurance, 2 per cent	15,000.00	
		$72,300.00
Labor:		
One chief engineer	$3,600.00	
Three assistant engineers, at $175	6,300.00	
Three operating engineers, at $140	5,040.00	
		14,940.00
Maintenance, 1½ per cent		11,250.00
Total fixed expense per annum		$98,490.00
Variable Expense:	Cents	
Lubrication—1 gal. per 2,000 kw.-hr., at 65 cents per gallon—per kw.-hr.	0.0325	
Fuel—10.7 kw.-hr. per gallon; 450 kw.-hr. per barrel, at $2 per barrel—per kw.-hr.	0.444	
At 80 per cent load factor—Annual output 35,040,000 kw.-hr.:		
Fixed expense		$98,490.00
Lubrication		11,400.00
Fuel, at $2 per bbl.		155,730.00
Total cost with fuel at $2 (Total cost per kw.-hr., 0.758 cent)		$265,620.00
At 60 per cent load factor—Annual output 26,280,000 kw.-hr.:		
Fixed expense		$98,490.00
Lubrication		8,550.00
Fuel, at $2 per bbl.		116,800.00
Total power cost with fuel at $2 (Total cost per kw.-hr., 0.852 cent)		$223,840.00
At 40 per cent load factor—Annual output 17,520,000 kw.-hr.:		
Fixed expense		$98,490.00
Lubrication		5,700.00
Fuel, at $2 per bbl.		77,865.00
Total power cost with fuel at $2 (Total cost per kw.-hr., 1.040 cents)		$182,055.00

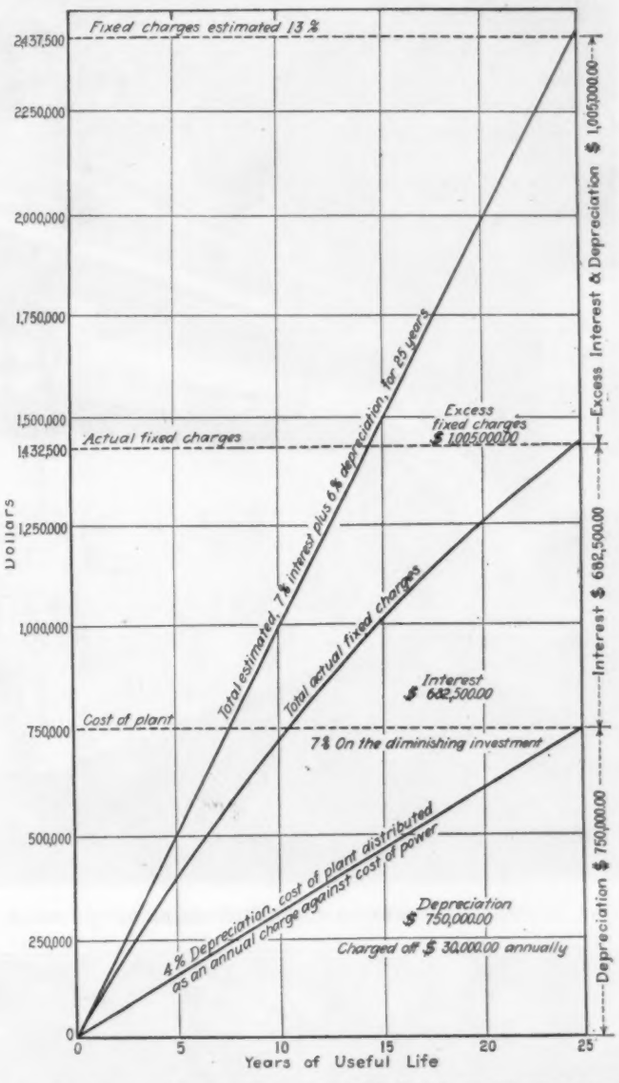


FIG. 3—EXCESS FIXED CHARGES OF $1,000,000 OFTEN ESTIMATED ON A DIESEL PLANT COSTING $750,000

$30,000 per year corrected for interest charges determined by the formula:

$$\text{Average interest on investment} = \frac{\text{interest rate (years} + 1) \div 2}{\text{years}}$$

This on a 7 per cent interest rate gives:

$$\text{Rate} = \frac{0.07\ (25 + 1) \div 2}{25} = 3.64 \text{ per cent,}$$

and the annual interest charge is 3.64 per cent of $750,000 = $27,300. The total annual charge for interest and depreciation is $30,000 + $27,300, which amounts to $1,432,500 in twenty-five years. This sum, representing twice the original investment, is used in giving service and is a proper charge against the cost of power.

Must Consider Fuel Economy

A preliminary estimate of the cost of Diesel power which loads a seven-hundred-and-fifty-thousand-dollar plant with an excess of $1,000,000 of fixed charges (Fig. 3) may lead to the installation of less economical prime movers unless it is known that the excess million dollars, which might be added to net earnings, would be paid out for fuel during ensuing years. Table II shows the total estimated cost for the 5,000-kw. station, and

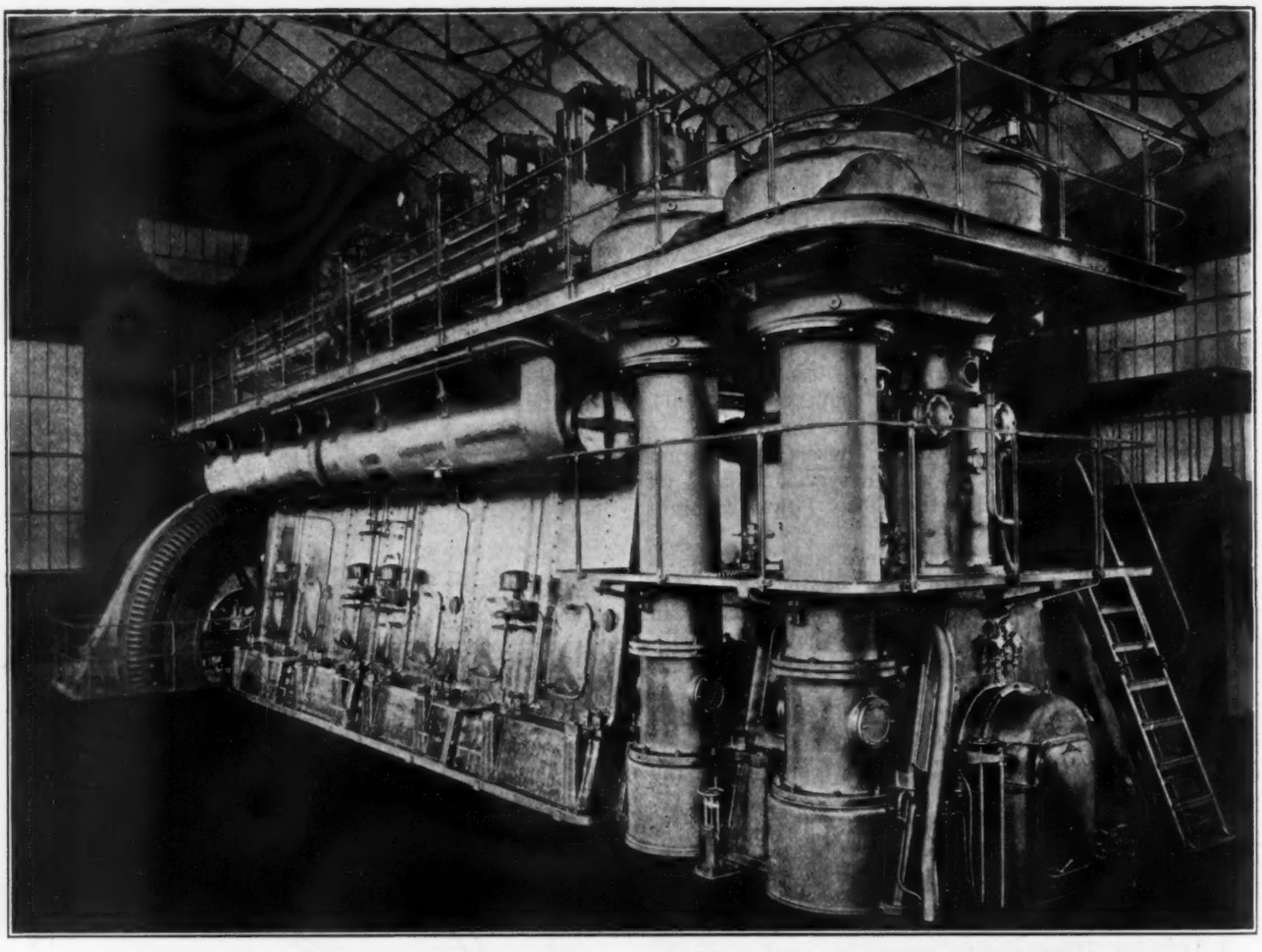
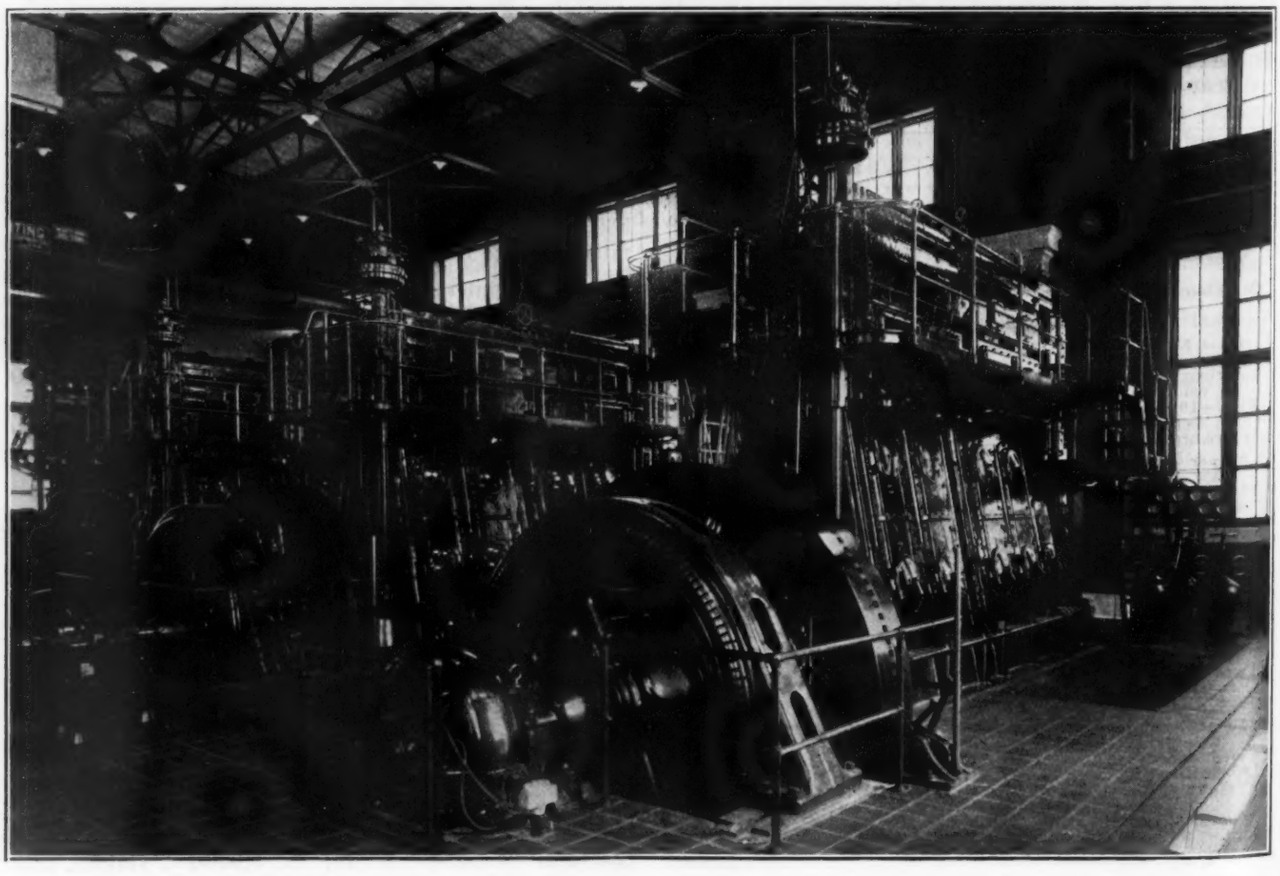


FIG. 4 (ABOVE)—A 4,000-B.HP. DIESEL UNIT. FIG. 5 (BELOW)—INTERIOR OF A THREE-UNIT DIESEL STATION



curves (Fig. 2) show operating costs for load factors from 25 per cent to 100 per cent with fuel costs at $1, $2 and $3 per barrel. An output of 450 kw.-hr. per barrel of fuel is based on a unit load factor of 70 per cent, and at full load over 500 kw.-hr. will be produced per barrel of 18,500 B.t.u., the oil weighing 7½ lb. per gallon. An important item is the fact that this economy will be constant throughout the life of the engines.

A 20,000-kw. Diesel station, consisting of five 4,000-kw. units, can be built on a lot 175 ft. x 200 ft. The four walls of the single building required would inclose a room 168 ft. long, 94 ft. wide and 46 ft. high. This lot will be sufficiently large to store sixty days' fuel supply in underground tanks.

Cooling water is a small item, since only 8 gal. of cooling water in circulation is required per brake-horsepower at 75 deg. F. inlet temperature, in order to dissipate about 3,000 B.t.u.s per brake-horsepower-hour. A single monolithic concrete block supports the five units, and each unit requires about 110 ft. of 22-in. exhaust piping, air ducts and oil and water piping of small size between the engine and oil tanks and water-cooling system.

The Diesel engine is simple in operation as it is placed in motion by compressed air, receives initial ignition from the heat of the cylinder, and compression is positive. An idea of its simplicity may be gained by stripping an automobile engine of its carburetor and ignition system and substituting fuel oil for explosive gasoline.

Only a failure of oil, air or cooling water will stop the operation of the unit, and automatic safety governors permit full load to be thrown on or off suddenly, with a return to normal speed in less than fifteen seconds. The duty of the operator consists chiefly in observing the lubrication system, the cooling-water temperature and the exhaust. The economy of the engine is self-controlled by the machine itself.

The Diesel plant, in common with plants of other types, requires high-grade mechanical work in its maintenance, but the payroll is small as only thirteen men are required in a five-unit, 20,000-kw. plant. These men would be a chief, three assistants in charge of shift, three operating engineers and six oilers.

A great advantage of the Diesel plant is that it can be located at the center of distribution. This saves distribution losses, reduces size of plant required, saves cost of transmission and transforming equipment and may serve to relieve the load on existing installations by placing the Diesels at the load centers to operate at about 90 per cent load continuously, floating on the system, carrying local loads and feeding excess into the main system.

As the difference in rate of fuel consumption and cost per horsepower is about the same in all sizes of Diesel engines, the use of from three to eight duplicate units is not objectionable. The flexibility and the simplicity of the plant in operation are improved by the use of duplicate units, which may be installed gradually as the load increases. As an advance guard to high-tension systems and as a developer of new territories the Diesel plant has proved very successful. In this type of service economy is obtained, and the unit becomes very valuable for auxiliary and standby service on the interconnected system that ultimately serves the territory.

The future of the large Diesel engine in America is largely in the hands of central-station engineers and executives. Until they demand it manufacturers will be slow to undertake the expensive development required to produce the very large units. The engine should be seriously considered for the reasons given as a very promising possibility for new stations. For many existing stations the installation of a Diesel engine of from 1,000 kw. to 4,000 kw. should offer many operating advantages and economies. It is hoped that this article will cause more serious consideration to be given to the possibilities of the Diesel engine as a very important unit for central-station use.

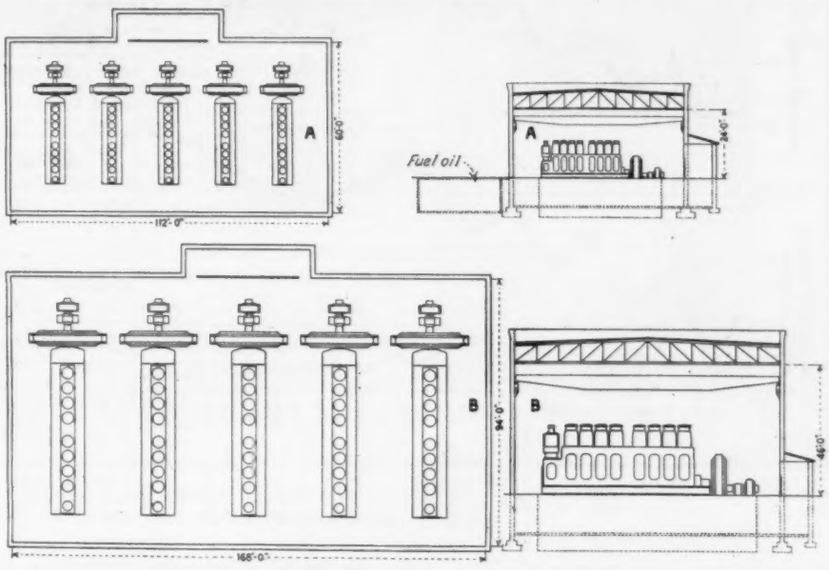


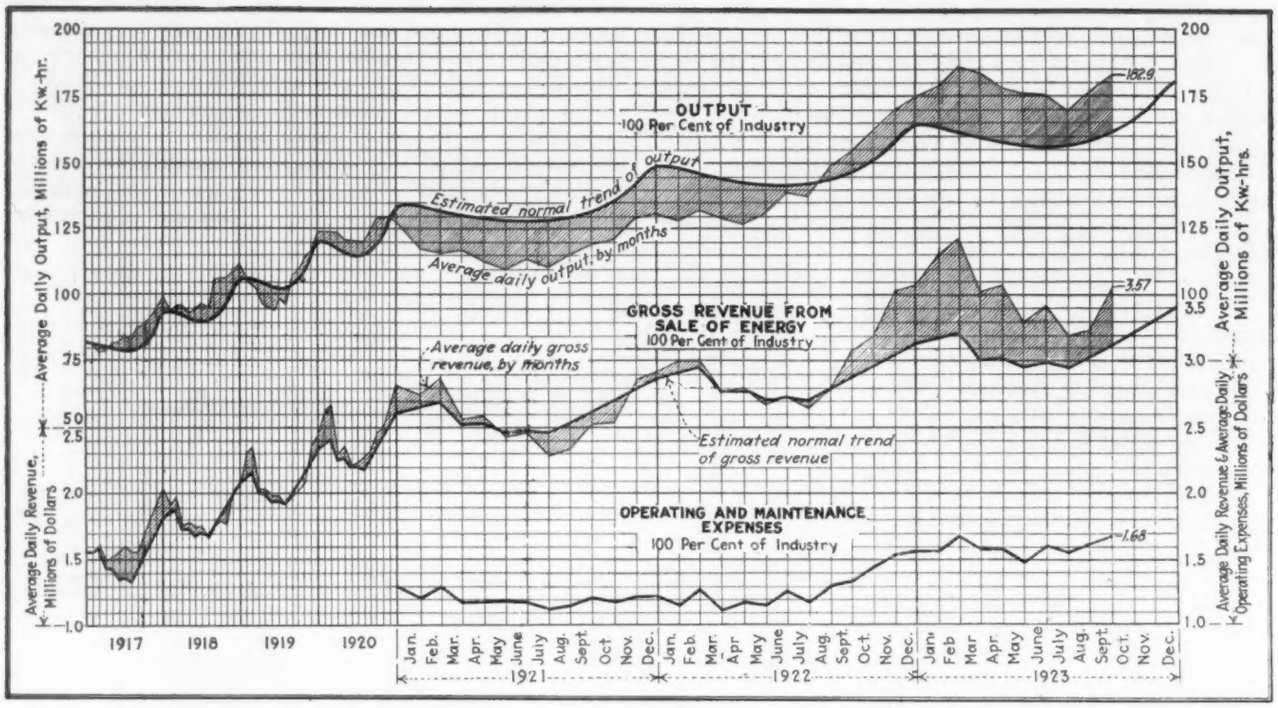
FIG. 6—COMPARATIVE FLOOR SPACE AND BUILDING REQUIREMENTS FOR 5,000-KVA. AND 20,000-KVA. DIESEL CENTRAL-STATION PLANT

Nine Months' Output Shows Gain of 23.7 per Cent Over 1922

September Output of Central Stations 12.9 per Cent Above Normal—Large Increase in Gross Revenue Over August

REPORTS received by the ELECTRICAL WORLD for the first nine months of the present year from central generating and distributing companies representing 75 per cent of the installed generator rating of the country indicate that the energy sold by the electric light and power industry during this period totaled 48,704,000,000 kw.-hr., a gain of 23.7 per cent over the energy sold during the first nine months of 1922. It must be remembered that this output figure includes energy purchased for resale, and is therefore in excess of the actual amount of energy generated. The monthly percentage gain in output has been decreasing since the beginning of the year. In January it was 28.0 per cent over that in January, 1922, while in September this gain over the previous year had dwindled to 15.8 per cent.

The South Central States report the largest percentage increase for the first nine months over a similar period for 1922 with 30.5 per cent, followed by the New



THE CENTRAL-STATION OUTPUT DURING SEPTEMBER WAS 12.9 PER CENT ABOVE NORMAL AND THE GROSS REVENUE WAS 14.1 PER CENT ABOVE NORMAL

England States with 28.4 per cent, Atlantic States with 26.6 per cent, North Central States with 22.3 per cent and the Mountain and Pacific States with 20.6 per cent.

The reports on revenue from the sale of energy for the first nine months of the year are also most interesting. The gross revenue of the industry for this period totaled $956,100,000, as against $809,150,000 for the first nine months of 1922, or a gain of 18.2 per cent. The record figure for revenue for the nine-month period was that reported during January, showing a total of $117,400,000 for the month.

Reports for the month of September indicate that the average daily output totaled 182,910,000 kw.-hr., which is considerably higher than that reported for August. A study of the accompanying diagram indicates that the central-station output for September was about 12.9 per cent above what would have been the seasonal energy requirements if the energy had been normal. The average daily revenue from the sale of energy during September was $3,570,000, a large increase over the revenue reported for August. This is 14.1 per cent above what would have been the revenue if growth in the industry had been normal.

TABLE I—CENTRAL-STATION RETURNS FOR THREE MONTHS

Mos.	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1923 Thousands	1922 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy (Companies Reporting) 1923 Thousands	1922 Thousands	Per Cent Increase
July....	76	3,992,518	3,305,235	20.8	70	$69,569	$58,877	18.2
Aug....	76	4,176,284	3,557,250	17.4	70	70,381	60,999	15.4
Sept....	75	4,115,526	3,555,408	15.8	69	73,912	65,480	12.9

Mos.	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies Reporting) 1923 Thousands of Dollars	1922 Thousands of Dollars	Per Cent Increase	OPERATING RATIO Steam Plants 1923	Steam Plants 1922	Hydro Plants 1923	Hydro Plants 1922	Combined Systems of Steam and Hydro 1923	Combined Systems of Steam and Hydro 1922
July....	59	28,381	24,148	17.5	52.0	55.3	28.0	27.9	45.0	46.1
Aug....	59	29,819	26,040	14.5	53.1	55.8	29.1	29.2	49.3	49.3
Sept....	59	29,736	27,034	9.9	51.1	55.2	31.4	22.4	53.5	52.6

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A THREE-MONTH PERIOD

Month	New England States: Percentage of Installed Ratings Represented	1923 Thousands	1922 Thousands	Per Cent Increase	Atlantic States: Percentage of Installed Ratings Represented	1923 Thousands	1922 Thousands	Per Cent Increase	North Central States: Percentage of Installed Ratings Represented	1923 Thousands	1922 Thousands	Per Cent Increase	South Central States: Percentage of Installed Ratings Represented	1923 Thousands	1922 Thousands	Per Cent Increase	Pacific and Mountain States: Percentage of Installed Ratings Represented	1923 Thousands	1922 Thousands	Per Cent Increase
KW-HR. OUTPUT:																				
July.....	73	289,828	226,028	28.2	76	1,469,301	1,168,106	25.8	73	1,220,628	1,045,528	16.8	57	195,989	158,765	23.5	89	816,772	706,808	15.5
Aug.....	73	308,117	255,493	20.6	77	1,527,480	1,269,734	20.4	73	1,277,669	1,108,287	15.3	57	207,638	172,516	20.4	89	855,380	751,220	13.9
Sept.....	74	298,401	253,763	17.6	76	1,505,305	1,291,822	16.5	73	1,274,564	1,105,579	15.3	57	219,295	185,909	17.9	88	817,961	718,335	13.9
REVENUE:																				
July.....	73	$6,887	$5,740	20.0	71	$26,500	$22,269	19.0	62	$20,043	$16,831	19.0	56	$4,519	$3,668	23.2	89	$11,620	$10,369	12.0
Aug.....	73	7,031	5,984	17.5	71	26,264	22,505	16.7	62	20,482	17,961	14.0	56	4,679	4,011	16.6	89	11,925	10,538	13.1
Sept.....	74	7,043	6,348	10.9	71	28,075	24,931	12.6	62	21,508	18,869	14.0	56	5,036	4,364	15.4	88	12,250	10,968	11.7
OPERATING EXPENSES:																				
July.....	44	$2,555	$1,763	45.0	58	$10,657	$8,699	22.5	52	$8,877	$8,029	10.5	56	$2,341	$2,027	15.5	87	$3,951	$3,630	8.8
Aug.....	44	2,660	1,997	33.2	59	11,032	9,285	18.8	52	9,489	8,963	5.9	56	2,366	2,086	13.4	88	4,272	3,709	15.2
Sept.....	45	2,483	2,031	22.3	58	11,097	9,726	14.1	51	9,391	9,045	3.8	56	2,389	2,247	6.3	90	4,376	3,985	9.8

Analysis of Interconnection Tie Line*

Study of Elements Involved in the Purchase of Energy Over One Tie Line by a Small Steam Station

MANY interconnecting lines are first built for the purpose of purchasing energy from another system. When any company is making a study of the problem of purchasing energy, it is necessary to take into consideration a number of essential factors shown in Table I. This table shows in some detail a study of the comparison between actual costs in the enlarged steam plant of a local company, called "Company A," and the actual cost (without profit to the delivering company) of purchased energy over a tie line from an adjacent larger company. This study is based on costs only, and the profit to the delivering company would be a part of and derived from the savings of "Company A."

These figures do not represent any actual system, but it is thought that the values in general are approximately correct. "Company A," which is making this study, has a steam generating plant capable of carrying 10,000 kw., with a peak load of 6,000 kw. At a distance of 29 miles is another plant of very large capacity which has sufficient installed capacity to carry additional loads of 10,000 kw. or 15,000 kw. without requiring the building of other plants. As is shown in the tabulation, it is much cheaper to pay carrying charges and energy charges on additional capacity in a large plant, plus carrying charges on the transmission line, than it is to install and operate the necessary equipment in the smaller generating plant. This is one of the incidental things brought out in Table I, as the table is primarily for the purpose of showing the proper method of analysis.

*Abstract from report of transmission lines committee, E. P. Peck chairman, presented at convention of Empire State Gas & Electric Association, Lake Placid, N. Y., Oct. 8-9, 1923.

TABLE II—COMPARISON OF COSTS BETWEEN (1) NEW STEAM PLANT AND (2) PURCHASED ENERGY BASED ON 132,000-VOLT OPERATION

	Year B		Year C	
Investment or Capital Costs	Steam	Purchased	Steam	Purchased
Present investment station A	$800,000	$800,000	$800,000	$800,000
Total investment station A	1,700,000	800,000	2,300,000	800,000
Investment in station B to be used for station A	.....	600,000	.....	1,080,000
Substation investment, 132 kv.	.....	368,000	.....	404,000
Line, 29 miles, at $19,000 mile, 132 kv.	.....	551,000	.....	551,000
Total capital cost	$2,500,000	$3,119,000	$3,100,000	$3,635,000
Fixed Charges and Annual Operating Cost				
Station A fixed charge, at 14.5 per cent	$246,000	$116,000	$333,000	$116,000
Station B demand charge, 14 per cent on part used for station A	.....	84,000	.....	151,000
Fixed charges on tie line and switch equipment at 14.5 per cent	.....	133,255	.....	138,475
Station B energy charge, at 0.8 cent per kw.-hr.	.....	320,000	.....	440,000
Operating cost station A: (1) (2)				
Year A..... 1.35	.....	.....	.....	.....
Year B..... 1.30 1.77	650,000	177,000	.....	.....
Year C..... 1.25 1.43	.....	.....	937,500	286,000
Total fixed and operating costs	$896,000	$830,255	$1,270,500	$1,131,475
Total saving in fixed operating costs by interconnection	.....	$65,745	.....	$139,025
Saving in initial investment to station A	.....	19,000	.....	545,000
Costs per kw.-hr., cents	1.79	1.66	1.69	1.51
Saving per kw.-hr., cents	.....	0.13	.....	.18

All of the other advantages of interconnection are not shown in this table. It is well in any particular study to consider very carefully the additional points of diversity in loads, combination of hydro-electric and steam plant operation and increased insurance against long-time interruptions.

It will be seen that the first section of this table sets up the present and prospective load conditions; the second section the investment and capital costs in the present system and in the proposed interconnection, and the third section the fixed charges and annual operating costs subdivided as is required for clear analysis. The conclusions are very interesting. At the end of year C, which may be four, six or ten years, the interconnection would save an investment of $1,052,000 to

TABLE I—COMPARISON OF COSTS BETWEEN (1) NEW STEAM PLANT AND (2) PURCHASED ENERGY OVER TIE LINES BASED ON 66,000-VOLT OPERATION

	Year A		Year B		Year C	
Physical Conditions	Steam (1)	Purchased (2)	Steam (1)	Purchased (2)	Steam (1)	Purchased (2)
Peak load, kilowatt-hours one hour	6,000	.....	10,000	10,000	15,000	15,000
Maximum available generating capacity, station A	10,000	.....	10,000	10,000	10,000	10,000
Additional capacity—steam or purchased	0	0	5,000	5,000	10,000	10,000
Capacity of tie line, station A to station B	.....	.....	.....	10,000	0	10,000
Effective capacity with largest unit or one tie line down	5,000	.....	10,000	10,000	15,000	15,000
Demand to be purchased from station B	.....	.....	.....	5,000	.....	9,000
Firm energy to be purchased from station B, kw.-hr., year (in thousands)	.....	.....	.....	40,000	.....	55,000
Firm energy generated in station A	30,000	.....	50,000	10,000	75,000	20,000
Total kw.-hr. per year (in thousands); annual load factor 57 per cent	30,000	.....	50,000	50,000	75,000	75,000
Investment or Capital Costs						
Present investment in station A	$800,000	.....	$800,000	$800,000	$800,000	$800,000
Total investment station A	800,000	.....	1,700,000	800,000	2,300,000	800,000
Investment station A, per kw. installed	80	.....	*180	.....	*180	.....
Investment station B, per kw. installed	.....	.....	.....	120	.....	120
Investment in station B to be used for station A	.....	.....	.....	600,000	.....	1,080,000
Substation investment	.....	.....	.....	100,000	.....	100,000
Line, 29 miles, at $12,000 per mile, 66,000 volts	.....	.....	.....	348,000	.....	348,000
Fixed Charges and Annual Operating Cost						
Station A fixed charge, at 14.5 per cent	$116,000	.....	$246,000	$116,000	$333,000	$116,000
Station B demand charge at 14 per cent on part used for station A	.....	.....	.....	84,000	.....	151,000
Fixed charges on tie line and switch equipment, 14.5 per cent	.....	.....	.....	65,000	.....	65,000
Station B energy charged at 8 cents per kw.-hr.	.....	.....	.....	320,000	.....	440,000
Operating cost station A (1) (2)						
Year A..... 1.35	405,000	.....	.....	.....	.....	.....
Year B..... 1.30 1.77	.....	.....	650,000	177,000	.....	.....
Year C..... 1.25 1.43	.....	.....	.....	.....	937,500	286,000
Total cost	$521,000	.....	$896,000	$762,000	$1,270,500	$1,058,000
Total savings in fixed and operating costs by interconnection	.....	.....	.....	$134,000	.....	$212,500
Saving in initial investment to station A	.....	.....	.....	452,000	.....	1,052,000
Cost per kw.-hr., cents	1.74	.....	1.79	1.52	1.69	1.42
Saving per kw.-hr., cents	.....	.....	.....	.27	.....	.28

*Investment per additional kilowatt of capacity.

"Station A" and would make a saving in fixed and operating costs of $212,500. The saving in kilowatt-hour cost would be 0.28 cent per kilowatt-hour.

"Station A," the home company, and "station B," the delivering company, may, in any given study, represent single plants or entire systems.

This tabulation is based on the simplest possible case in order to make it clear, and it does not show all of the possibilities which may be obtained in more complicated situations. However, even in this case a very substantial saving is shown by "Company A" in total investment and in operating costs.

A small company was used for the illustration in Table I, because it is generally harder to show economies in a case with light loads than it is if heavy loads are involved. On account of the small amount of power under consideration, the transmission line was taken for operation at 66,000 volts. If lines and substations had been considered for 132,000 volts, the savings would have been reduced. There is still some saving, however, as is shown in Table II, which covers the same general situation with costs figured for 132,000-volt construction.

High-Voltage Trunk Lines Tapped for Local Service

THREE-PHASE trunk lines carrying voltages of 100 kv. or more frequently pass small settlements and farms that would like to benefit by electric service. Often the high cost of a transformer installation to meet the small demand of these consumers, amounting to only a few kilowatts, makes this either technically difficult or economically impossible. A transformer of 5-kva. capacity suitable for giving such service and built for a voltage ratio of 110,000 to 110 would require physical dimensions not materially different from those of a 500-kva. transformer, and as a result the cost of the small transformer per kilovolt-ampere would be enormous. Another use for small power is the night illumination of transmission lines at highways, rivers, railways, etc. For these cases an unusual and apparently very economical system has been developed

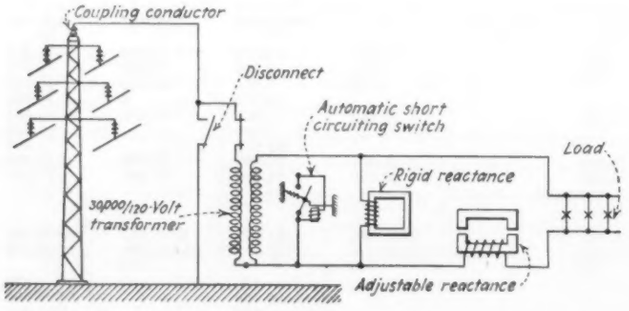


FIG. 1—SMALL COMMUNITIES MAY BE SERVED POWER BY THIS COUPLING ARRANGEMENT

and successfully tried out in Germany, according to R. Deuser in the August-September issue of *Siemens Zeitschrift*.

It is well known that an electric field rotates around every energized three-phase transmission line. If a conductor is introduced into this field parallel to the line, it will assume a voltage against ground. If this conductor is connected through resistance to ground, a current will flow through the resistance, returning from ground by means of the capacity of the line. The induced voltage will depend upon the operating voltage of the power line and the relative arrangement of the power lines and the "coupling conductor," as it is called. The voltage in the coupling conductor will drop if current in phase with the power line is taken from it and will rise if reactive current is taken from it. By a combination of phase current and reactive current in a certain relative proportion the useful voltage may be kept constant. The useful energy available increases with the length of the coupling wire.

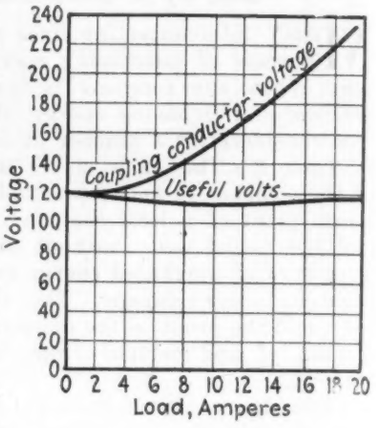


FIG. 2—VOLTAGE CHARACTERISTICS OF COUPLED CIRCUIT

In co-operation with a large power company practical tests were made with this arrangement on a suitable stretch of a 100,000-volt line near Berlin. The ground wire was used as the coupling conductor by insulating it from the steel towers for a distance of about 1½ miles. The arrangement of coupling wires and transmission cables is shown at the left in Fig. 1. The useful current (120 volts) is obtained from the secondary of a small single-phase, 30,000/120-volt transformer. The arrangement of rigid and adjustable reactances, etc., as shown in Fig. 1, is used to keep the secondary of 120 volts constant. How well this has been achieved is shown on the curves of Fig. 2. For the arrangement shown a useful energy of about 1 kw. has been obtained per 0.6 mile of coupling conductor and a highest voltage of 30 kv. in the conductor.

Arizona Reports Large Central-Station Growth

The United States Census Bureau has just issued the following data on the central stations in the state of Arizona:

	1922	1917	Per Cent* of Increase 1917–1922
Number of establishments	31	29	.....
Commercial	27	25	.....
Municipal	4	4	.....
Income	$3,974,000	$2,141,000	85.5
Electric service	$3,917,000	$2,103,000	87.6
All other	$57,000	$38,000	—50.0
Total expenses, including salaries and wages	$3,170,000	$1,752,000	80.9
Number of persons employed	608	436	39.4
Salaries and wages	$861,000	$451,000	90.9
Total horsepower of prime movers	71,922	38,662	86.0
Steam engines and turbines:			
Number	29	28	.....
Horsepower	22,029	23,870	—7.7
Internal-combustion engines:			
Number	28	15	.....
Horsepower	11,862	3,592	230.2
Waterwheels and turbines:			
Number	23	4	.....
Horsepower	38,031	11,200	239.6
Kilowatt capacity of dynamos	48,765	26,972	80.8
Output of stations, kw.-hr.	147,370,000	65,732,000	124.2
Number of consumers' meters in service	48,231	24,303	98.5
Number of customers	38,134	24,320	56.8

* A minus sign (—) denotes decrease; percentages not shown where base is less than 100.

Forty Lighting Intensities in One Street

Experimental Installation at Cleveland for Studying Lighting Principles Varies from 100 Cp. to 3,000 Cp.

STREET lighting is not keeping pace with the increasingly rigid requirements imposed by the rapid growth of cities in the United States and the addition of hundreds of thousands of motor cars every year on the already congested streets. Furthermore, before it will be possible to convince city and central-station officials generally that the lighting problems of their particular cities can be solved through the application of sound engineering principles there must first exist among engineers themselves a reasonable degree of unanimity of opinion on the fundamental principles of the art. It has been generally felt that the difference of opinion on the part of engineers is primarily due to the incompleteness of fundamental data on the visibility of objects under various systems of street lighting. Investigations by various individuals and organizations have contributed substantially to this knowledge; but, even with the information resulting from these tests, there are still many important factors which have not as yet been definitely evaluated.

With the hope of contributing to the basic facts of the science, the engineering department of the National Lamp Works, Cleveland, Ohio, in co-operation with the Cleveland Electric Illuminating Company and the Municipal Department of Light and Heat, has installed a full-scale experimental set-up (Fig. 1) for investigating and demonstrating the principles underlying thoroughfare and residential district lighting. The installation covers a 2,000-ft. section of a typical Cleveland street, East 152d Street. It consists of some forty separate lamp circuits—virtually forty streets in one—and each circuit illustrates a definite principle of correct illumination. Lamps ranging from 100 cp. (1,000 lumens) to 3,000 cp. (30,000 lumens) in size, with spacings from 75 ft. to 900 ft., are mounted at heights from 11 ft. to 26 ft. The location of units ranges, by four successive steps, from 2 ft. back of the curb line to the center of the street, bracket arms being used.

This installation affords by far the most comprehensive demonstration of street-lighting principles and effects ever installed. It is the only place in the world where comparison of a wide variety of lighting effects upon the street can be made instantly. It is planned to conduct a number of investigations on this street under the various lighting effects for a wide variety of conditions, with the view of properly evaluating the different factors involved and obtaining definite information regarding the particular characteristics of each system.

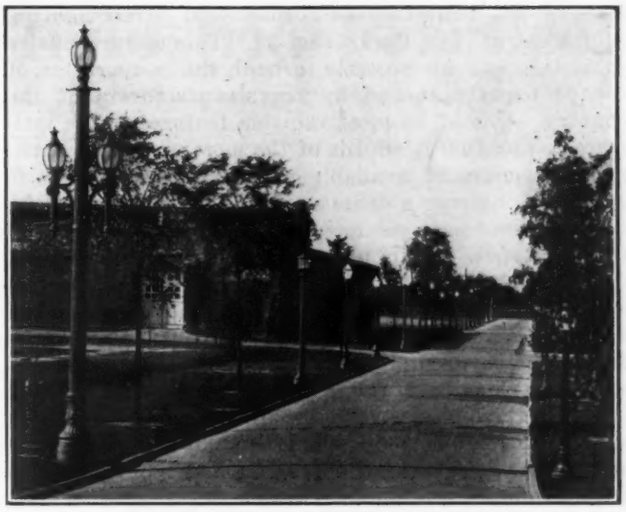


FIG. 2—ORNAMENTAL STREET-LIGHTING EQUIPMENT AT NELA PARK

This equipment affords a means of comparing various types of posts and fixtures during the day or night.

This installation will also serve another distinct purpose, apart from its research function. The selection of a suitable street-lighting system by a town or city has always been rendered somewhat difficult on account of the lack of an opportunity to view a number of different street-lighting systems at one time and to compare their characteristics with respect to the specific requirements of that town or city. With this demonstration available at Cleveland, city officials, city engineers, civic organizations and central-station officials now have an opportunity to view at one time the various standard types of street-lighting systems that are available in order to compare their individual characteristics of appearance and light distribution.

In addition to the 152d Street demonstration there

FIG. 1—LIGHTING INSTALLATION, EAST 152D STREET

With all the systems turned on, this street has approximately five times as much illumination as any other street in the world. The magnitude of the intensity can be gaged from the way the cracks in the roadway show up.

also is an exhibition of ornamental street-lighting equipment at Nela Park (Fig. 2). This comprehensive exhibition is made possible through the co-operation of the principal post and fixture manufacturers of the country. One of its most valuable features is the intimate comparison it affords of the most up-to-date ornamental equipment available at the present time. It gives the observer a definite idea of the day and night appearance of any one unit as compared with the other modern types. Each unit can be turned on and off individually so that its appearance when lighted, as well as its particular characteristics of light diffusion and distribution, may be observed without interference from neighboring units.

To every engineer who is interested in street lighting in any of its phases, and to all municipal, civic and central-station officials desiring to study right upon the street the various kinds of systems and types of equipment available, a cordial invitation is extended to view both of these exhibitions. Arrangements to do so at any time may be made by writing to the engineering department, National Lamp Works, Cleveland, Ohio.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Engineers and Manufacturers

To the Editors of the ELECTRICAL WORLD:

On page 939 of the ELECTRICAL WORLD for Nov. 3 there appears an article by H. W. Young which should not be allowed to stand unchallenged. Mr. Young's idea is that apparatus design and development should be left entirely to the manufacturers, who sometimes, when they are in particularly good spirits, would generously allow some engineers to make suggestions, using their own judgment in deciding whether or not the suggestions should be considered. What do engineers know about high-tension apparatus, anyhow? When they need a new substation all they should do is to tell Mr. Young about it and, like good boys, wait and see what he gives them, and then merely "O.K." the bill for their clients to pay. Engineers should not "play with toys" for fear that they might break them.

Where would the industry be today if engineers had stopped playing with toys, say, twenty years ago? Would manufacturers have developed 50,000-kw. turbines if they had not been forced to do it by demands of engineers? They would not, because they can make more profit if they sell ten 5,000-kw. units instead of one 50,000-kw. unit. Neither would they have developed any 30,000-kva. transformers, since there is more money in selling thirty 1,000-kva. units. All this is so obvious that it is hardly necessary to dwell on it. There is more money in standard stuff which is already developed and tried out, and naturally some small manufacturers who have not the facilities for developing new devices would be happy to stop the wheels of progress and not go to higher voltages, larger units, better switches, better insulators, etc. It costs manufacturers a great deal of money to develop new things, so why not try to sell the old stuff?

A study through the history of the electrical industry will prove that nearly all new developments are better than the old ones, and that nearly all new developments were suggested not by manufacturers but by engineers who were "playing with toys" and who forced them upon the manufacturers because of the operator's demand for ever better apparatus.

May the day never come when the engineers stop "playing with toys," for this would mean the end of progress! Engineers must and will continue playing with toys, and new toys must and will be developed all the time, and those manufacturers who refuse to play with them will sooner or later have to stay out of the game altogether.

M. M. SAMUELS.

New York.

Australasia Backward in Things Electrical, but Change Is Coming

To the Editors of the ELECTRICAL WORLD:

I have noticed with interest reference in an American periodical to the new policies which are being adopted by Australian electric supply authorities and consequent improvement in the prospects before electrical traders.

The Melbourne City Council, which supplies the city and a portion of the suburbs with energy, has recently adopted a tariff under which users of 72 kw.-hr. per month can have the whole of their electricity on a flat rate of 1¾d. per unit. This is much the cheapest electrical energy that has been sold in Australia. This authority recently bought £1,000 worth of electric cooking apparatus and now has an expert testing samples from a large number of British, American, Canadian and Australian manufacturers. After the conclusion of these tests steps will be taken by the Council to push the sale of the type which it considers most suitable for local conditions.

The Victorian State Electricity Commission, which will ultimately control all electric supply in this state, is also keenly interested in electrical household helps, and when its large generating station at Yallourn is completed next year will be obliged to "boost" the domestic load in order to sell its output.

In Tasmania the Hydro-Electric Department has surplus energy at present and is developing both city and country districts rapidly. Energy in that state is cheap, and electric cooking and other household devices are finding increased sale.

In New South Wales the Sydney City Council, one of the largest central-station proprietors in Australia, is considering the idea of spending £4,000 a year for three years on advertising electricity, on condition that traders find £6,000 a year for the same period.

This is a small beginning, but it is a beginning, and Australia is almost a virgin field for the electrical trader. Generally speaking, the electrical installation in the Australian home today averages about one lighting point per room, and in 99 per cent of the cases there is no other outlet. Most persons use electric flatirons, taking energy from a lamp socket.

In New Zealand things are worse at present than in Australia. Supply is mostly in the hands of power boards, shortage of plant is common almost everywhere, and in several of the leading cities the use of radiators, for instance, is banned altogether or during peak-load hours.

Soon all this will be changed, and both in Australia and New Zealand a great trade will be done in electrical appliances. People here will buy freely when they feel the want of electrical help at home, and they are being educated today as never before.

W. DAVEY,

Managing Editor "Australasian Electrical Times."

Melbourne, Australia.

Central Station and Industrial Practice

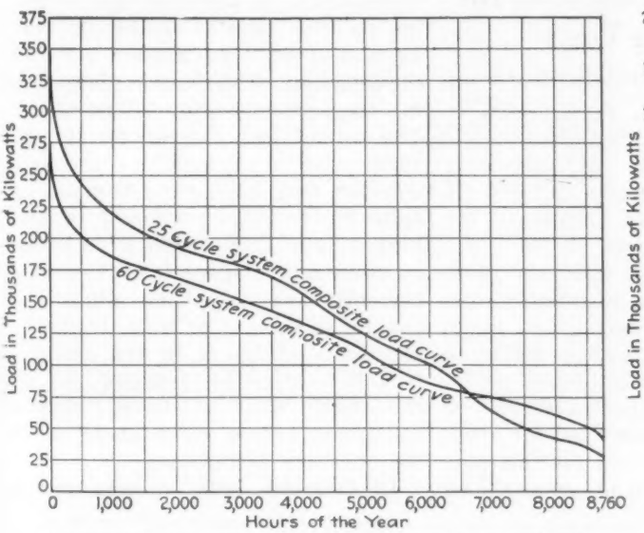
Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Construction of Composite Load Curves

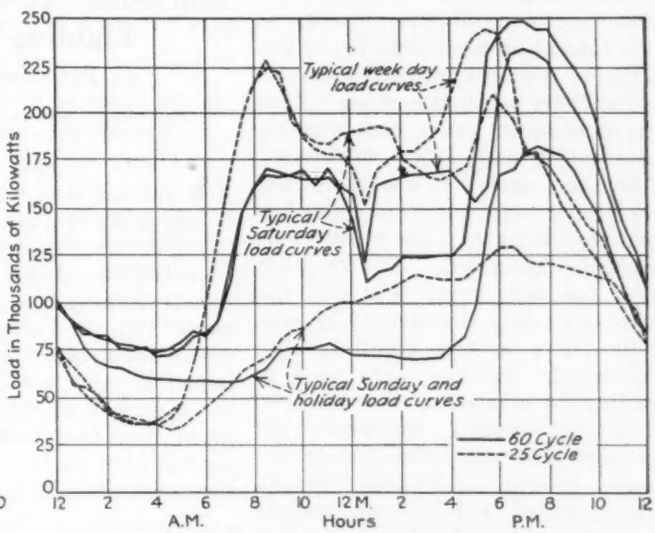
Representative Days Chosen in Order to Lessen Labor of Calculation —Method of Procedure Outlined in Detail

By Stanton S. Bailey
Distribution Division, Commonwealth Edison Company, Chicago

IN ORDER to have a basis for planning the installation of new and more economical generating units, the engineers of the Commonwealth Edison Company thought it would be desirable to construct a composite load curve. This curve has the kilowatt load upon the system for its ordinate and the hours throughout the whole year as its abscissa. Thus every point on the curve represents a certain load on the system for a definite number of hours during the year. The area under the curve represents the total number of kilowatt-hours generated. These curves aid in the decision whether it will be cheaper to carry the peak loads on the old and uneconomical units or whether it will be more economical to install new and more efficient units. Thus arises the old question of fixed charges versus savings in operating costs. When the savings in operating costs equal the fixed charges on the new investment, then is the time to install new units.



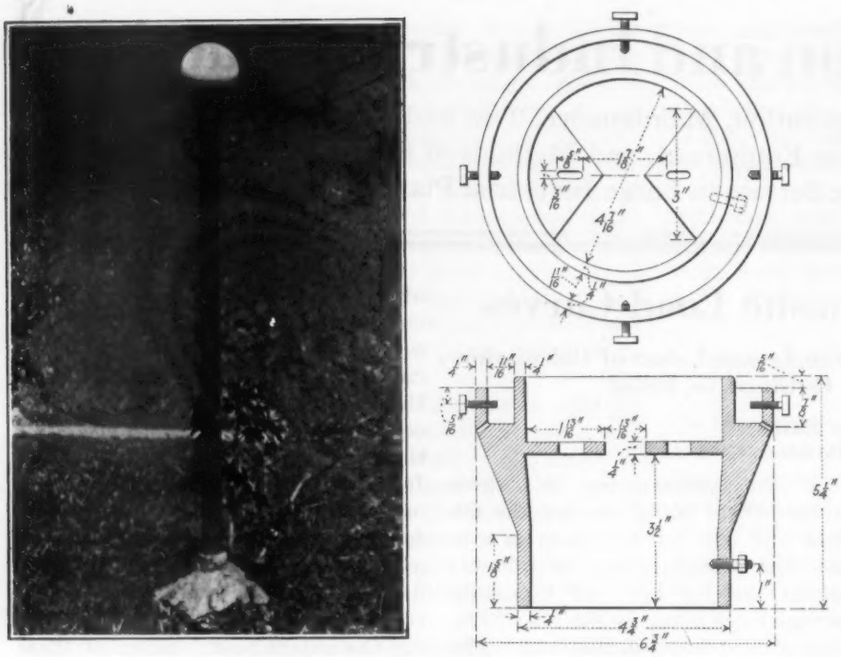
COMPOSITE LOAD CURVES GIVING THE HOURS OF ENERGY DEMAND DURING A ONE-YEAR PERIOD



TYPICAL LOAD CURVES OF THE COMMONWEALTH EDISON COMPANY'S 25-CYCLE AND 60-CYCLE SYSTEMS

In the construction of these curves—there being one for the 60-cycle and one for the 25-cycle system—the procedure was as follows: Taking the log table of the daily average loads covering the year 1922, certain days were picked out. The reason for choosing these particular days was that they seemed to be representative of certain groups of days. Another reason for choosing representative days was to save time and much useless routine labor. The percentage of error introduced by this method of choice is negligible. For example, all the Sundays of the year were divided into thirteen groups of four each, and one Sunday was taken as representing each group. The same thing was done with the Saturdays. Each holiday was taken separately. Corresponding with each group of Saturdays and Sundays there was another group of nineteen or twenty weekdays, depending on whether or not a holiday occurred in that group, out of which one representative day was chosen. In order to get the maximum and minimum values of the curve, the days of the weeks in which the maximum and minimum loads occurred were taken separately, while the weeks immediately preceding and following the maximum and minimum were each taken as a group of four or five days. This again depended upon the occurrence of a holiday. In this way a list of sixty representative days was obtained covering the entire year. Seven of these composite days each represented twenty days, four others typified nineteen days, four more represented five, twenty-eight others stood for four days and the remaining seventeen each represented one day. Since the accuracy of the composite load curve depended upon the deliberate choice of these representative days, they were chosen with extreme care.

Next the daily system load curves for these sixty representative days were studied. From them a tabulation of the kilowatt load for every half hour was made giving a total of 2,880 readings, divided into the groups as explained above. Readings were made only to the nearest 5,000 kw. as this was thought ac-



SIMPLE LIGHTING UNIT FOR PLANTS AND SUBSTATIONS

curate enough for the purpose. The maximum and minimum points in this tabulation were next found and a list of readings in 5,000 steps between these points was made. Then the number of times each reading occurred in each group was found. When the whole list was completed, the proper constants were applied so that the total hours' use of each load could be computed. The constant used for each group was half the number of days represented by each daily curve in the group because half-hourly readings were used in making the tabulation. For example, each load reading represents the average load upon the system for some definite half-hour period. Therefore, if a particular reading occurs ten times in a group representing twenty days, that means that this average load is on the system for ten half hours or five total hours per day, making a total of one hundred hours for this load in that particular group. This gave a table showing the load in 5,000-kw. steps and the hours' use of each load during the year.

When these tabulations were plotted the composite load curves shown were obtained. Besides being used as mentioned above, the curves have been found useful in checking rough calculations on the cost of producing energy, there being known the number of hours of operation and the operating costs for each generating unit on the system; in estimating energy cost for coming years, and in determining load factors.

Old Boiler Tubes Used for Lighting Posts

BY FREDERICK KRUG

Superintendent of Hydro-Electric Plants, Porto Rico Railway, Light & Power Company, Bayamon, Porto, Rico

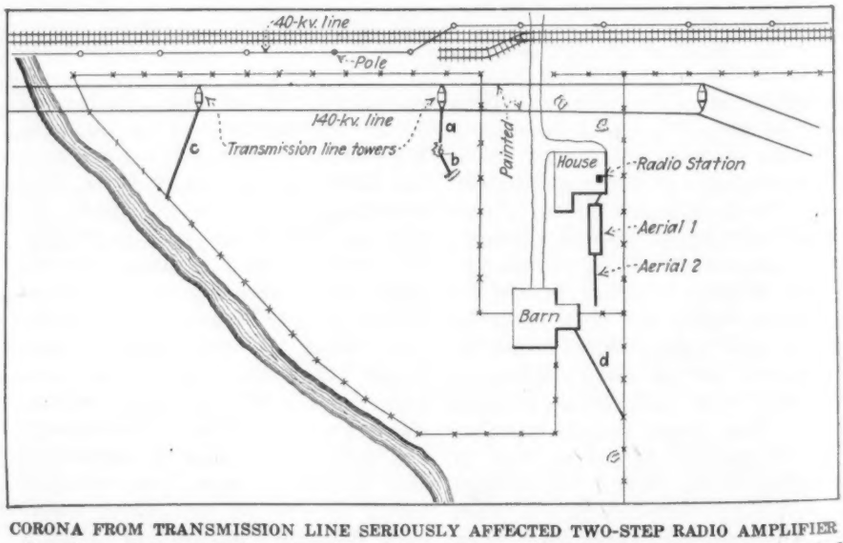
A VERY simple yet decorative lighting post made up from old boiler tubes is used around all the plants and substations of the Porto Rico Railway, Light & Power Company. This company annually discards from its steam plant many 4-in. boiler tubes which, while no longer of value in a boiler, are useful for a variety of other purposes. A great many have been used for ornamental light posts, and for this purpose castings were made up as shown in the drawing. The castings were designed to fit the standard 6-in. x 12-in. "Alba" opal globe.

Some of these posts were wired with underground cable, but in most cases a small stone and concrete base was built around them to give added stability and the wires were carried on iron brackets, as shown in the accompanying illustration.

Inductive Troubles Between Transmission Circuits and Radio Sets

CASES of inductive troubles between transmission and distribution lines and radio receiving sets are presenting a somewhat acute problem. One that occurred recently on the system of the Consumers' Power Company in Michigan indicates some of the problems that central-station operators must face as the number of radio receiving sets increases. The owner of the receiving set lives close to one of the 140-kv. and 40-kv. transmission lines of the company. The situation is shown in the accompanying illustration. The owner had started in March, 1922, with a regenerative set and detector and, having no trouble, in spite of the close proximity of the high-voltage line, added a two-step amplifier and loud speaker. The man evidently knew what he might encounter in the way of inductive troubles as is evidenced by the care he took in locating his antenna and by the trial with relatively simple equipment before going ahead with the complete installation.

In October, 1922, it was found



CORONA FROM TRANSMISSION LINE SERIOUSLY AFFECTED TWO-STEP RADIO AMPLIFIER

Location of transmission circuits, radio receiving antenna and test set-ups used in the investigation. Antennas Nos. 1 and 2 are the ones originally installed and on which the trouble occurred. *a*, *b*, *c* and *d* are the set-ups. That at *d* is about 400 ft. away from the transmission line and practically eliminated the disturbance.

necessary by the company to change the conductors on the 140-kv. circuit, and a new wire consisting of seven strands of No. 8 A. W. G. copper was substituted for the old one, which consisted of six strands of No. 6 copper with a hemp center. The outside diameter of both the old and the new conductor is 0.39 in. Trouble with the radio set commenced at once and was found to be due to corona discharges from the new conductor. Static discharges between the strands of the new conductors could be seen from the ground. The owner of the set suggested that an insulating paint would be of some help. This was put on the latter part of November and apparently had some effect in reducing the inductive disturbance. The various test setups made in the investigation are shown in the illustration. It was found in these tests that while reception of distant radiophone stations was possible there was enough disturbance to be very annoying in tuning and listening to these stations. In installing the new wire it, of course, received some bruises that left sharp points and encouraged static discharges. As the conductor weathered there seemed to be a lessening of the trouble and painting assisted still further.

As a final remedy it was suggested that antenna No. 1 be removed to a distance of 500 ft. from the transmission line and that the lead-in wire to the set be carried underground with an insulated conductor. This would put the antenna out of range of the static discharges as shown by the tests, and the insulated conductor for underground would provide sufficient shielding for the lead-in wire. It was also suggested that the receiving set be placed in a box shielded by sheet copper with the shield grounded and that the owner of the receiving set install a separate ground in place of using the lightning-rod ground as he was doing when the case was investigated.

Underground Cable Record System Valuable

BY F. L. ROHRBACH
Engineer Underground System Washington Water Power Company, Spokane, Wash.

THE underground cable and subway system of the Washington Water Power Company is laid out in a diagrammatic manner on a large board on the wall of the station, as in Fig. 1, which shows at a glance what cables pass through each manhole and what duct space is available in any subway. The streets of the business section of Spokane are shown by heavy black lines, and in the middle of each block a shipping tag showing a cross-section of the subway in that block is hung on a hook. An enlarged section of the board with the four tags in each direction from the street intersection is shown in Fig. 2. By a system of symbols and numbers these tags give all necessary information about each cable.

With this system, if the dispatcher is notified of a fire in a certain manhole, he consults the board and can readily see what cables are involved. The scheme is also very useful in routing cables.

Laying Cable Economically by Special Plow

BY J. W. SYLVESTER
Superintendent Alternating-Current and Arc Underground Lines, Philadelphia Electric Company

A SPECIAL plow built for installing parkway cable in the grass plots between curb and sidewalks in residential streets and on private property has been very successfully used by the Philadelphia Electric Company. This company has installed 28 miles of cable by this method on the Roosevelt Boulevard in Philadelphia and has used it in a number of suburban towns for incandescent street-lighting purposes. Long underground services on private property have been installed with perfect success. In all of these installations the ordinary lead-covered cable has been used, it being found unnecessary to resort to steel-armored cable. The company fully believes that this method has been justified because of the exceedingly low cost of maintenance of this type of installation.

In laying cable by this method a hole about 18 in. deep by 2 ft. square is dug at the point where the cable plow is to begin its work. The cable is attached to the rear end of the torpedo-shaped prong which forms the lower end of the plowshare, about 18 in. in front of which is a harrow disk which serves to cut the sod in front of the plowshare. The plow is drawn along the surface of the ground by means of a cast-steel running rope attached to a gasoline-driven winch, which is secured to

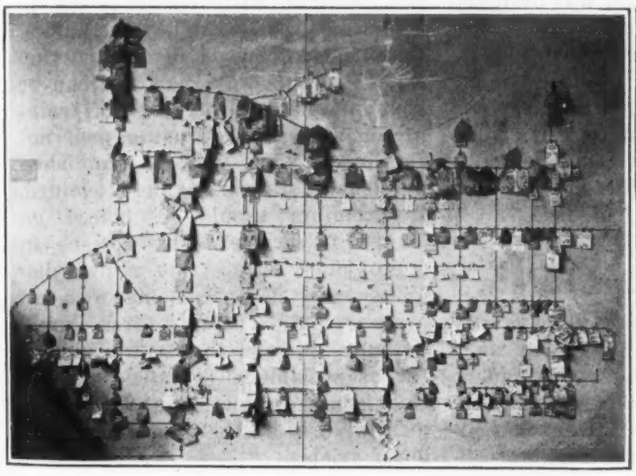


FIG. 1—AVAILABLE DUCT SPACE CAN EASILY BE LOCATED WITH THIS TYPE OF GRAPHICAL RECORD

□ tile duct; O fiber duct; last two figures (as 01, 23, 41, etc.) indicate feeder number; next figure to left (1, 2, 3, e c.) indicates station from which the cable feeds; remaining figures to the left (2, 3, 13, etc.) indicate the voltage of the cable; "con" means concentric cable. Example: "3541-con" means concentric cable, feeder No. 41 from station 5 operating at 300 volts. Two or more numbers in a duct symbol indicate that a multi-conductor cable is being used in the specified duct.

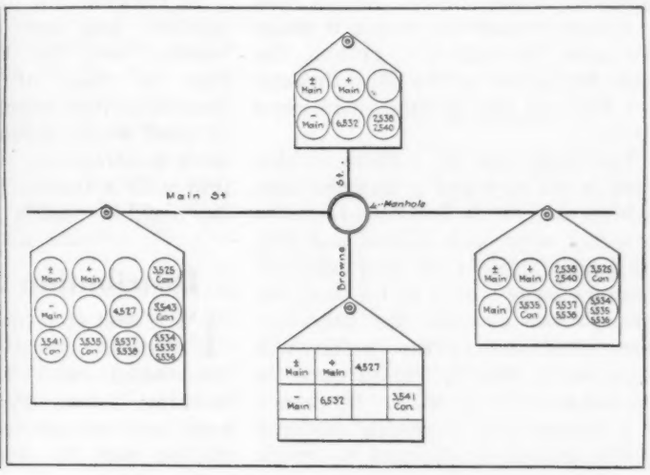
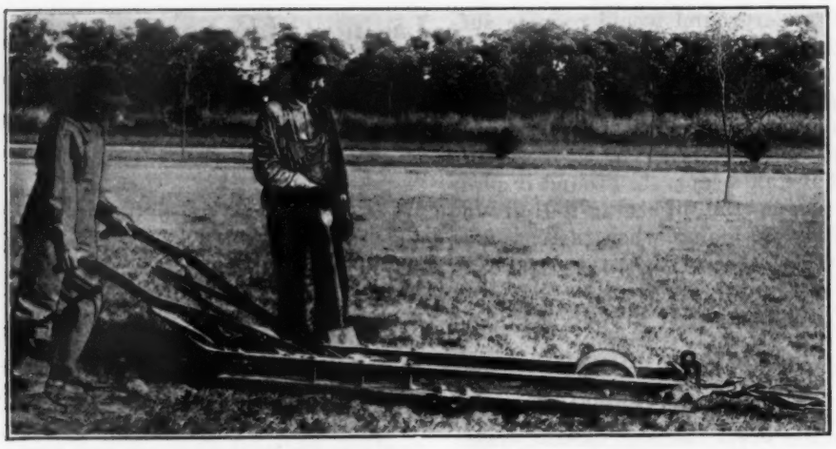


FIG. 2—NUMBERS ON TAGS INDICATE VOLTAGE, FEEDER NUMBER AND ANNEXATION



CABLE-LAYING PLOW USED SUCCESSFULLY BY THE PHILADELPHIA ELECTRIC COMPANY

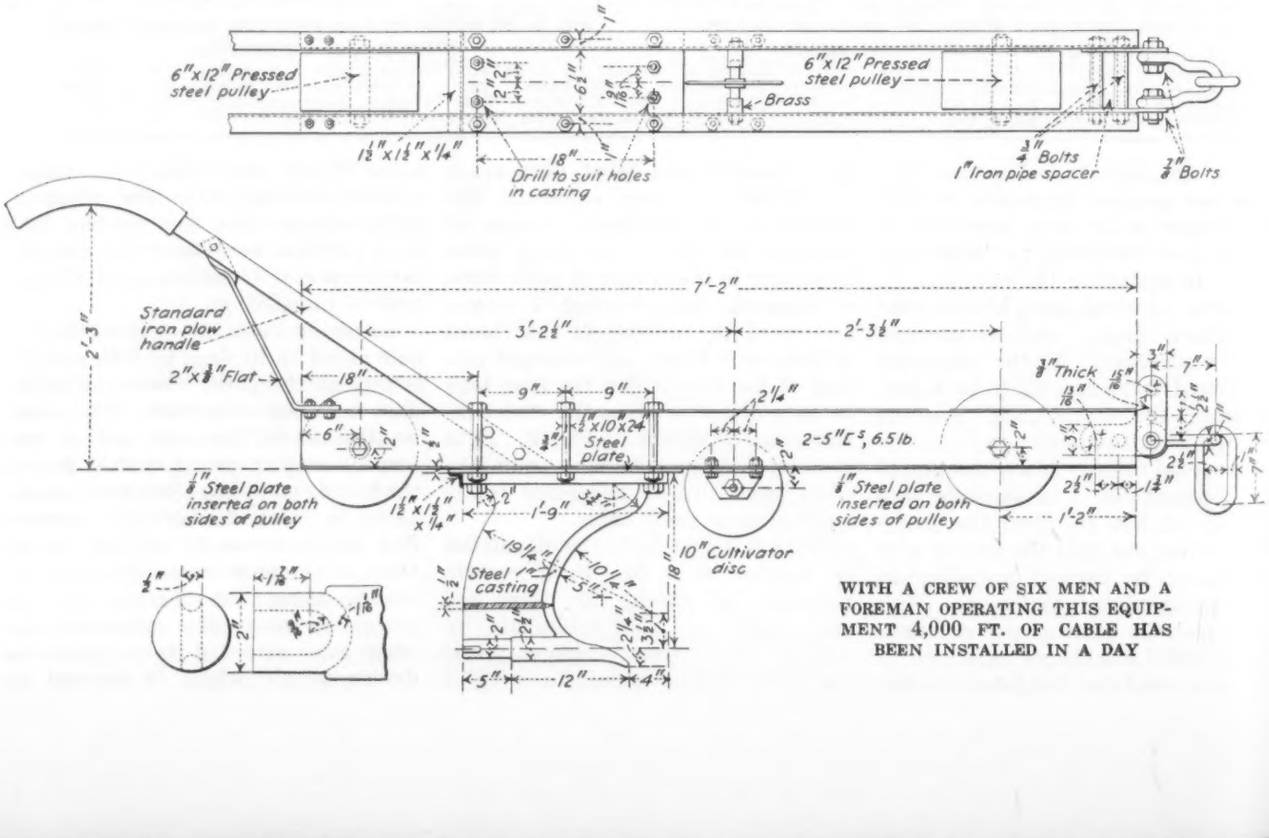
the ground at a point in the distance to which the cable plow is drawn. This distance is usually not over 600 ft., although cable has been pulled in this manner a distance of 800 ft. The longer distance is not, however, recommended. As the plow is drawn toward the winch it drags the cable through the ground, the cable being fed to the plow through the hole in the ground mentioned above.

The usual size of a crew on this work is six men and a foreman, and as high as 4,000 ft. has been installed in a day with such a crew and this equipment. Unless the plowshare encounters large stones in its progress through the ground, the only evidence of it seen on the surface will be a small, slightly raised seam in the sod about ½ in. wide. By means of a tamper this is readily restored to the original grade, and the work is so neatly done that unless one were looking for it, it would be imperceptible. Of course, if the plow meets with stones, it usually results in the tearing up of the sod, but this can be readily remedied.

At the time this plow was designed tractors had not come into economical use, but the writer feels that in place of a cumbersome gasoline-driven winch a tractor could be used which would be very much more satisfactory. He has no doubt that with a tractor the 4,000 ft. per day could be readily increased.

Distribution and Safety

THE first step in attaining proper attitude toward safety and other established rules is a permanent working force. Formerly systems were built up hurriedly, but central-station work is now so well established that nearly every operating company can maintain a more or less permanent working force in the outside plant department. This can be accomplished by making inspections of the system and planning necessary but deferred maintenance work in advance so that it can be done during the off-peak periods in construction work. In this way the force can be kept busy and the expense of training new men or of using men not familiar with the established methods or standards can be avoided. A premium should be placed on length of service. This can be in one of many forms, rate of pay, disability and death benefits, pension systems, etc. The line force should be built up from the bottom and as far as possible all vacancies should be filled by promotion and the new men hired to fill the vacancies in the lower grades.



WITH A CREW OF SIX MEN AND A FOREMAN OPERATING THIS EQUIPMENT 4,000 FT. OF CABLE HAS BEEN INSTALLED IN A DAY

Small High-Voltage Units Must Be Avoided

BY W. S. MOODY
Engineer Transformer Department,
General Electric Company,
Schenectady, N. Y.

THERE is a common misconception that when high voltages capable of transmitting power economically over 250 to 500 miles are used every hamlet along the route can have electric power. The cost of transforming at such high voltages is far too great to make it commercially feasible to supply small customers unless there are enough

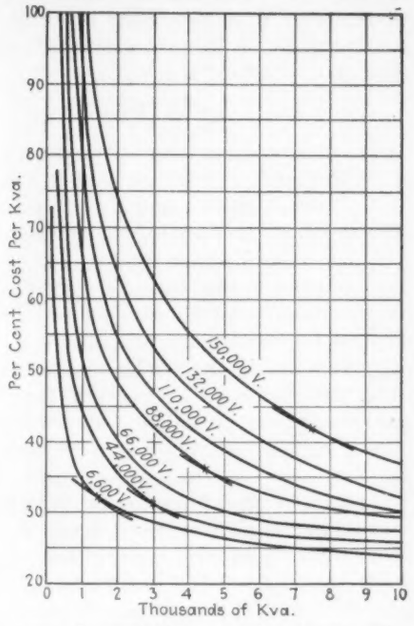


FIG. 1—RELATIVE COSTS PER KVA. OF TRANSFORMERS OF VARIOUS VOLTAGES

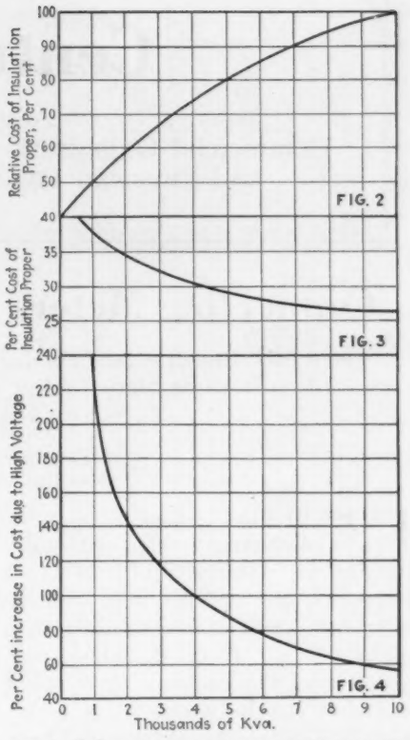
of them situated so that they can be collected into a unit of service at a much more moderate voltage.

Often the demand is so scattered as to require three successive transformations before the individual user is reached. The relative cost per kilovolt-ampere of self-cooled transformers of different sizes designed for different voltages is shown in Fig. 1. The portion of the curve where the cost per kilovolt-ampere takes a rapid upward turn indicates the minimum size below which it is not usually economical to go, and it will be noted that the higher the voltage the larger is the size at which this occurs. Thus, if, for comparison, we take the points where the curves have a 30-deg. slope upward, we find that this occurs at 1,500 kva. on the 6,600-volt line, 3,000 kva. on the 44,000-volt line, 4,500 kva. on the 88,000-volt line, and 7,500 kva. on the 154,000-volt line.

Small units must therefore be avoided, not only because all manufactured devices cost more per unit capacity as the size of the device becomes smaller, but because the economic lower kilovolt-ampere limit in high voltages is much higher than at low voltages, on account of the fact that the vital and expensive part of a high-voltage transformer —namely, its insulation—is for a given voltage almost constant in cost regardless of size.

The relative cost of the insulation proper of 150,000-volt transformers is shown in Fig. 2, and it is interesting to note that the cost of the insulation proper of a small transformer is as much as 40 per cent of that of a 10,000-kva. transformer. Fig. 3 gives the cost of insulation proper in percentage of total cost of the transformer. Although these curves alone would be sufficient argument in themselves, there is a further fact to be considered, namely, that the insulation proper is only one part of the high cost entailed by high voltages, and that the excess cost due to larger size of tank, core, coils, clamps and oil necessitated by the larger clearances demanded for such insulation is also chargeable against the cost of high voltage.

Since in power-size transformers the lowest cost is at 6,600 volts, we will take the cost of the 6,600-volt self-cooled line as a basis and express the excess cost of 150,000 volts in various kva. sizes in Fig. 4 in percentage of the cost of the corresponding 6,600-volt unit. It is interesting to note that 150,000 volts costs about 54 per cent more at 10,000 kva., but about 220 per cent more at 1,000 kva., and prohibitively higher a smaller capacities.


Relative Cost of Insulation Proper, Per Cent
FIG. 2
Per Cent Cost of Insulation Proper
FIG. 3
Per Cent increase in Cost due to High Voltage
FIG. 4
Thousands of Kva.

FIGS. 2-4—RELATIVE INSULATION COST AND EXCESS COST OF 150,000-VOLT TRANSFORMERS

Fig. 2—Relative cost of the insulation proper of 150,000-volt transformers in per cent of that of a 10,000-kva. unit.
Fig. 3—Cost of insulation proper of 150,000-volt transformer in per cent of total cost of transformer.
Fig. 4—Excess cost of 150,000-volt transformers above those of 6,600-volt transformers in per cent of the cost of the latter.

Aside from the advantage in cost in favor of larger sizes, there is also an unusual advantage in efficiency in favor of the larger sizes as shown by Fig. 5.

Minimum sizes used on any voltage should therefore be well beyond the zone where the cost per kva. increases rapidly. Transformers for the highest operating voltages such as 220,000 volts should preferably be above 10,000 kva. per phase.

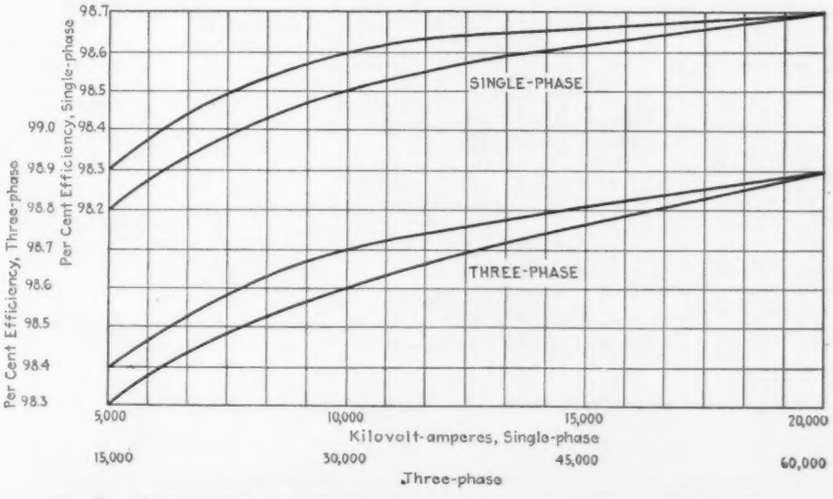


FIG. 5—EFFICIENCIES OF SINGLE-PHASE AND THREE-PHASE TRANSFORMERS AT A POTENTIAL OF 220,000 VOLTS

Connecting Meters Within Eight Hours

Systematic Routine in Scheduling Orders Minimizes Delays—Applications Signed After Meter Installation—Electric Service Left Connected

By J. H. Thomas
Chief Clerk Central Illinois Light Company, Peoria, Ill.

IN HANDLING more than 2,500 gas and electric service orders per month the Central Illinois Light Company has reduced the average time for setting meters to less than eight hours. This, of course, considers only the working time where a meter installation alone is necessary. Where line extensions must be built more time is necessary. This company serves 22,000 electric and 19,500 gas customers in Peoria, and a carefully worked out routine is followed to facilitate quick action in connecting meters.

Orders to connect service are taken by the order department from customers in person or by telephone. In either case the application "A," together with form "B," is completed and passed to the credit department, which is adjacent to the order department and operates as a division of it. When the credit has been approved—that is, if the application is for "old work" where the service is already installed—the order is placed in a "ready file." Telephone orders on "old work" follow the same routine, and if credit is approved, the application is mailed to the customer for signature, together with a letter signed by the secretary of the company. If a deposit is necessary the manager of the credit department writes the customer to that effect, but in either event the order is not delayed since it is placed in the "ready file."

New Construction Procedure

On orders requiring new extensions the applications are held in the order department pending completion of inspection by the municipal inspection department. Each day, however, the construction department reviews these new orders so that its work may be planned in accordance with them. Upon receipt of a certificate of inspection from the municipal inspector the "new work" orders are placed in "ready file."

At 11 a.m. and 4 p.m. each day all service orders are removed from the "ready file" and are typewritten in duplicate on form "C," which is similar for electric and gas service. These forms and a register copy are obtained in one operation. After

A—Service application blank. B—Meter set or connect service order. C—New construction order. D—Tag on entrance switch informs new customer how service can be restored.

Form 23½—10m **A** APPLICATION FOR ELECTRIC SERVICE

NAME.....

Central Illinois Light Company.

.....Ill., ...19.....

I hereby make application for electric service to be supplied to

No.....St. Floor.....Apt.....and for the installation of an electric meter to measure same and agree to pay at your office all bills for service rendered according to your published rate schedule now in effect or hereafter established, and until forty-eight hours after written notice to discontinue the supply has been given you.

I further agree that the supply of electricity hereby applied for shall be subject to your regulations pertaining to electric service, the receipt of a copy of which is hereby acknowledged.

This application will not become effective until accepted by one of your officers.

All prior agreements with you are merged in this instrument.

Accepted.....
Executive Officer

X _____
Customer

In consideration of your supplying service under above application, I hereby guarantee the payment of all bills for service supplied to above applicant within ten days from date such bills become due.

Owns property at..... Signed.....(Seal)

Form 6–3M **B**

ADDRESS

NAME

SET METER	GAS	ELECT.	RATE	REMOVE METER	GAS	ELECTRIC
CHANGE TENANT	GAS	ELECT.	FROM (OLD CUSTOMER'S NAME)	CHANGE METER	GAS	ELECT.

DEPOSIT OR GUARANTOR

MAIL BILL TO

NEW JOB | OLD JOB | ORDER TAKEN BY | DATE

REMARKS:

OVER

Form 30–10M–3-21 **C**

ELECTRIC
METER ORDER
CENTRAL ILLINOIS LIGHT CO.

Order | Address
Date | Name
Rate | Order to
Job | Send Final to
Remarks:

MAKE	MFR. NO.	CO. NO.	AMP.	VOLTS	CONST.	INDEX

Location

How Connected

Remarks

Completed by Date 192

Addressograph	Meter Read Card	Meter Record	Consumer Ledger

D

Form 147–2M

Service Discontinued

FOR
RECONNECTION

CALL 4-3340

Ask for ORDER DEPARTMENT

CENTRAL ILLINOIS LIGHT CO.

Office 316 S. Jefferson Ave. Peoria, Illinois

FORMS USED BY CENTRAL ILLINOIS LIGHT COMPANY IN HANDLING SERVICE ORDERS

SERVICE CONNECTIONS—JUNE, 1923

Class	Number of Orders	Average Time per Order, Hours	Minutes
Unlocks, gas and electric	439	1	22
Install meter, gas, old job	146	7	43
Install meter, electric, old job	72	7	59
Install meter, gas, new job	98	18	32
Install meter, electric, new job	174	25	56

typing, the orders are turned over to the "lock-unlock" clerk, who checks each set order against a file of the meters which are locked and also against the customer's ledgers for the meter number, etc. The lock and unlock orders are held in the commercial office and the remaining orders which require the installation of meters or "new work" are sent to the respective departments for completion. Thus the larger part of the orders taken by the order department in the morning are ready for the workmen by 1 p.m. A summary of work for the month of June, 1923, is given in the accompanying table, which shows the average elapsed time for all connections. Obviously it takes less time merely to unlock meters than install them and it requires still longer time where construction is necessary.

Electric installation meter orders are handled by the electric distribution department. Orders on old work are checked against a card file to insure that the correct kind and size of meter is used. On new work the meter setters are advised each day where new services are being run, and they endeavor to route their work so as to follow the new orders as closely as possible.

Electric Service Left Connected

For several years this company has been using the plan of leaving the meters installed when a customer discontinues the use of service. However, this practice is restricted to residences, offices and smaller stores only. When meters are locked a red card is attached to both the electric and gas meters explaining how service may be obtained. Where this service is of both kinds the gas meter only is locked. The main electric switch is opened, however, and the red card "D" placed upon the panel. When the customer telephones to have the service connected he is instructed to close the main switch to obtain immediate electric service and is told the approximate time that the "meter-set man" will call to unlock the gas service. It has been found that one man with a car is able to handle electric and gas "locks," "unlocks" and "change tenant readings" by covering the city twice daily. He telephones to the office at 10 a.m. and 3 p.m., and any "rush" orders to unlock meters are given him at that time. He works out of the commercial office direct, rather than from either the gas or the electrical distribution department.

As indicated in the time of connections, there is particular advantage in quick service to the customer when the meters are allowed to remain installed. The man who handles the "unlocks" has found that the customers appreciate service, since hardly a day goes by that he does not receive favorable comment from some customer in regard to the prompt service given.

Aside from the gain in revenue due to the earlier use of service, there is also the advantage of a considerable saving over setting and removing meters with every change of customer and the necessary meter tests resulting therefrom. There is no question that this prompt connection of service is appreciated by the customer, and if in his initial contact with the company he receives immediate and courteous service, the company may be sure that public good will is being built upon a firm foundation.

Courteous Letter Asking Customer to Sign Service Application

Dear Mr. .....

In compliance with your telephone request, we are connecting your premises at the above address for service and, as promised, are inclosing for your signature our regular application contract form. Please sign on the line marked "customer" and return to us in the inclosed envelope at your earliest convenience.

We are glad to have you as a customer at this new address and want you to know that we appreciate the opportunity of continuing our service, which we hope will prove satisfactory in every way. It is our aim not only to furnish an uninterrupted and dependable supply of gas and electricity, but also to serve you individually and personally through the several departments of our organization on all occasions.

We realize that mistakes may happen, that our service may not always be all we aim to make it. If so, we shall appreciate your telling us in what respect we have failed that we may have opportunity to correct our shortcomings. Our telephone number is 4-3340.

Putting Appliance Operating Costs on Envelopes

TO HELP customers in checking their bill variations to a degree as different appliances are added to their installations, the United Electric Light Company, Springfield, Mass., has recently placed a tabulation of average hourly operating costs of such devices on the backs of its envelopes. This information, which is shown in the accompanying table, answers many inquiries which arise in the customer's mind as to the probable operating expense of appliances not in the service of an individual customer.

TABULATION PRINTED ON BACKS OF ENVELOPES

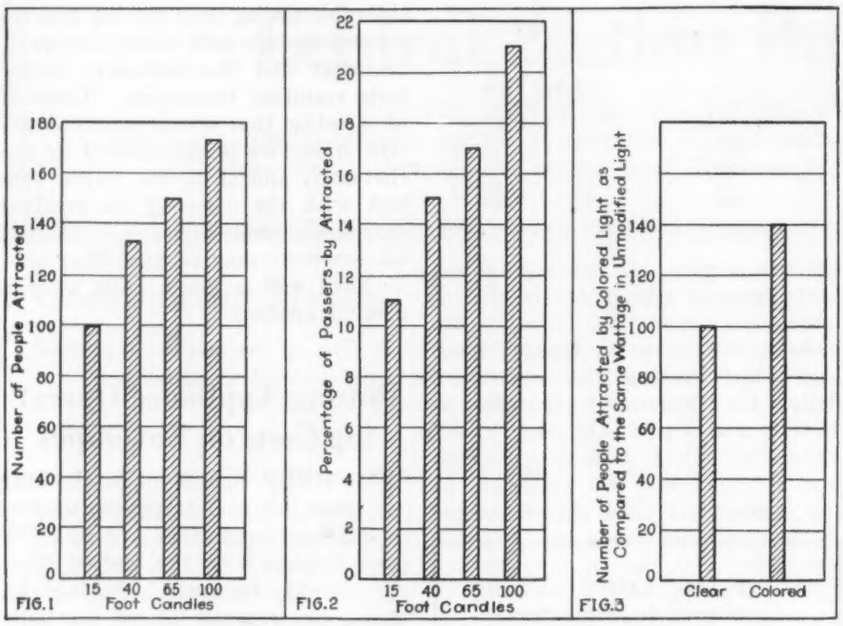
Average cost per hour for operating the following electric appliances:

	Cents		Cents
Flatiron	5	Heating pad	½
Toaster	4½	"Hedlite" heater	6
Vacuum cleaner	1½	Fan	¾
Washing machine	2	Percolator	4½
Curling iron	½	Chafing dish	5½
Grill	5½	Ironing machine	2
		Sewing machine	1

Effectiveness of High-Level Window Illumination

HIGH-LEVEL illumination and color effects will materially increase the number of passersby who pause to view displays, said A. L. Powell, lighting service department, Edison Lamp Works, General Electric Company, at the recent Swampscott convention of the New England Division of the N. E. L. A. This is indicated by the accompanying chart, which is based on observations in 106 individual test runs in two widely separated representative cities.

Central-station lighting solicitors are making capital out of the qualitative information shown, which indicates increased interest on the



PULLING POWER OF WINDOWS INCREASES WITH LIGHTING INTENSITY

Fig. 1—Thirty-three per cent more passersby stopped to look at this window when the intensity was increased from 15 ft.-candles to 40 ft.-candles, while 50 per cent more stopped when the intensity was raised to 65 ft.-candles, and 73 per cent when raised to 100 ft.-candles.

Fig. 2—With an intensity of 15 ft.-candles, 11 per cent of the total number of passersby were attracted; with an intensity of 40 ft.-candles 15 per cent stopped; up to 100 ft.-candles, 21 per cent stopped.

Fig. 3—With a high intensity it was found that by using color caps with no increase in wattage 40 per cent more passersby stopped to examine the display.

part of the public as intensities and color displays are heightened. Broadly speaking, Mr. Powell said, there are two general types of standardized reflectors, one suited to high, narrow windows and the other to low, deep windows. The installation of these reflectors with 100-watt lamps on 12-in. to 20-in. centers, depending on the intensity of illumination in the neighborhood, will meet average conditions in an excellent manner.

What Other Companies Are Doing

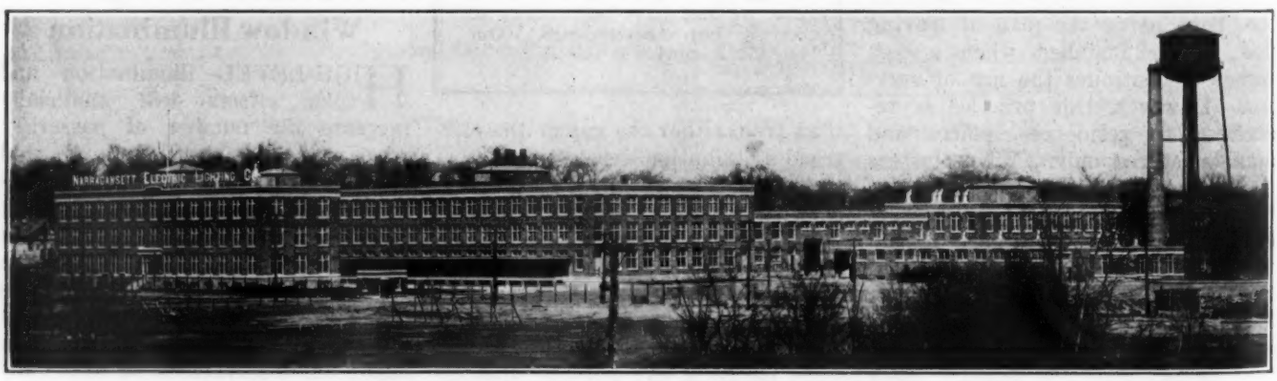
Ashland, Wis.—Through the efforts of W. J. Hodgkins, vice-president of the Lake Superior District Power Company here, the land around the local power house of the company will become one of the "show places" of the city. A landscape gardener has been engaged to take charge of the work of turning the unsightly grounds surrounding the plant into a small park. This work is estimated to cost about $3,000 when completed.

Logansport, Ind.—With the completion of the plant of the Northern Indiana Power Company, four days have been designated as visiting days for the public. On these days a committee of employees will serve as guides to any one who desires to visit and inspect the plant.

Boston, Mass.—Appliance sales by utilities operated by Charles H. Tenney & Company are now running about 40 per cent ahead of last year's figures.

Montreal, Canada.—The second customer-ownership campaign of the Southern Canada Power Company was even a greater success than its first one, conducted in 1922. The campaign opened Oct. 27 and was scheduled to run for ten days with 4,000 shares to be sold. At noon on Oct. 30 the company found it necessary to halt the campaign, 5,485 shares having been disposed of, or a 40 per cent oversubscription with two and a half days' work. In 1922 a total of 2,358 shares was sold to 932 shareholders in four days. The 5,485 shares sold this year went to 1,668 shareholders. The sales were made by employees of the company, 240 of them participating. They made 10,261 calls during the campaign. An unusual feature of the campaign was the fact that of the 1,668 persons who purchased securities more than 1,300 were new subscribers, so that the company now has more than 3,000 of its 15,000 customers financially interested.

All Service Departments Combined in Impressive Building



BEHIND the scenes in modern central-station service lie many activities unimagined by the general public. The utility customer knows of the existence of a generating station and the necessity for a distribution system appeals to him, but few customers visualize the ceaseless work which must be done in order that men and materials shall be concentrated at particular points on the system at stated times; that supplies shall be purchased and stored in readiness for immediate delivery at any hour of day or night, and that facilities for testing apparatus and material and for keeping accurate and complete accounts of service transactions shall be organized and maintained.

These problems have been solved by the Narragansett Lighting Company of Providence, R. I., in its new Melrose service station shown above. Erected this year after an exhaustive study of previously built installations of the kind, this plant represents an investment for better service of upward of $750,000.

The Melrose service station combines offices for operating and engineering executives with extensive stockkeeping facilities, quarters for the transportation department, laboratory, meter storage and testing departments, light and heavy stockrooms, customer records and employee recreation facilities.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Review of the Fuel Situation in Canada.—A discussion of the Dominion Fuel Board, report which deals with the recurring hard-coal shortages in Canada and which contains suggestions for the more general employment of bituminous coal and other fuels, principally of Canadian origin. This three-and-one-half-page article considers the various uses of fuel in Canada, comparison of fuels and the aspects of future supply.—*Canadian Engineer*, Oct. 16, 1923.

Condensing Plant for 20,000-kw. Turbine at Shanghai.—This surface condensing plant is of the Hick-Breguet type and is designed to condense 239,000 lb. of exhaust steam per hour and maintain a vacuum of 28 in. at the exhaust inlet to the condenser, with a barometric pressure of 30 in. and when supplied with circulating water at 80 deg. F. The amount of circulating water required is 2,400,000 gal. per hour, the cooling surface being 40,000 sq.ft. As the condensing water contains a considerable amount of fine mud in suspension, special attention has been given to the avoidance of reduction in vacuum due to the deposit of such foreign material on the inside of the tubes.—*Engineering (England)*, Oct. 19, 1923.

Upper Falls Development of the Washington Water Power Company.—L. J. POSPISIL.—The author describes a recent hydro-electric development in the center of a city, this plant having a single vertical-shaft generator and delivering its output to the buses of an existing distribution substation 350 ft. distant, the excitation and load control of the new generator being from the substation. The principal features of the development are the auxiliary devices to assure reliable operation of a remotely controlled unit and provision for an automatic shutdown of the unit in case of serious trouble; also the automatic bypassing of a large portion of the water used by the wheel if the load is greatly reduced.—*Journal of A. I. E. E.*, November, 1923.

Generation, Control, Switching and Protection

Field Excitation Switch.—E. POIRSON.—The high inductivity of the generator field requires a special construction of the switch which opens this field to divert the unavoidable overvoltage from the pole windings. Usually a double knife switch is used, the auxiliary knives opening an instant after the main blades separate, closing the field upon a fixed external resistance. The results obtained are, however, not always fully satisfactory. Three new methods are suggested to improve such a switch. The first is the use of a double-pole twin switch, with resistances in series with the field and between the twin knives. The resistances are in normal operation short-circuited by the longer blades. When opening, the long blades separate first, cutting the resistances in the circuit for an instant, whereupon the shorter blades open the weakened field. The second suggestion is that the protective resistance be placed as additional steps at the end of the field-regulating resistance, turning the handle always to the very last position before opening the simple main field switch. The last and most recommended solution prescribes a suitably dimensioned condenser across the field through which the overvoltage is discharged. Formulas are given for the calculation of the size of the condenser needed.—*Revue Générale de l'Electricité*, Oct. 6, 1923.

Features of Importance in Circuit-Breaker Design.—E. K. READ.—In the design of a circuit breaker there are several factors that must be carefully considered. It is not enough that the apparatus be able to carry the greatest current at the rated voltage and interrupt a given current whenever called upon to do so. The size and weight of the apparatus must be considered because they affect the design of the switch house. The cost of erection and preparation for service must also be considered as the purchaser is primarily interested in completely installed costs.—*Electric Journal*, November, 1923.

Transmission, Substation and Distribution

Cables and Accessories for Agricultural Purposes.—ELVIO SOLERI.—The portable cables which connect the main transmission line to the different portable motors working in the fields are of a great importance and extensively used in electro-agriculture. These special cables differ from the other ones mainly by an external mechanical protection which has an influence upon the mechanical and electrical characteristics of the cables themselves. Considering first what is the maximum length and the highest permissible voltage of the cables, the author shows how experiments were made and what the results were as concerned insulation, durability, flexibility, handling, current capacity, weight, losses, safety, cost and upkeep of many different types of cables. As accessories the author considers the joints between cables and between cable and permanent line, switches, etc.—*Elettrotecnica*, Sept. 25, 1923.

Design of Transmission-Tower Lines.—W. DREYER.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the A. I. E. E. fall convention, Oct. 20, 1923, page 799.—*Journal of A. I. E. E.*, November, 1923.

Shunt Operation of Rotary Converters.—R. J. SAULSBURY.—In the early part of 1923 the Pittsburgh Railways System adopted shunt operation for 60-cycle converters, and during the first six months the time of power outages was reduced to less than half that occurring with compound operation. Since the change flashovers have become almost entirely eliminated.—*Electric Railway Journal*, Nov. 10, 1923.

Units, Measurements and Instruments

Design Constants and Measuring Units.—L. E. WIDMARK.—This paper presents a generalization of a method described in a previous paper by the author ("An Arrangement of the Circle Diagram," *Journal of the A. I. E. E.*, September, 1922). The author suggests an interdependence between measuring units and the design constants of a machine and, employing this method, proceeds to outline the direct "unit parabola diagram" for direct-current machine, the "unit circle" arrangement of the Behrend circle diagram and the "C. S. U." (cross-section unit) reference system where length dimensions take the place of ordinary electric units in recording the electrical data of a machine.—*Journal of A. I. E. E.*, November, 1923.

Cathode-Ray Oscillograph.—D. A. KEYS.—The cathode-ray oscillograph and its application to the exact measurement of explosive pressures, potential changes in vacuum tubes and high-tension magnetos are discussed. After a description of the apparatus a few experiments are described which indicate some of the various applications and possibilities of the methods developed. With this oscillograph it is possible to measure changes in pressure or potentials which occur in 0.00001 second or less. New avenues of research are consequently opened for investigation which should result in practical results of economic and commercial value.—*Journal of Franklin Institute*, November, 1923.

Illumination

Visibility of Radiant Energy.—K. S. GIBSON and E. P. T. TYNDALL.—In cooperation with the Nela Research Laboratories a new determination of the visibility of radiant energy has been made by the step-by-step method, an equality-of-brightness method with little or no hue difference in the two parts of the photometric field. Energy values were based upon radiometric and spectrophotometric measurements made at the bureau, checked by an independent color temperature measurement at the Nela Research Labora-

tories. Luminosity values were obtained with a Brace spectrophotometer. Detailed comparisons are made between the individual and average results of this investigation and those of previous investigations. A revision of the I. E. S. mean curve is proposed which results in better agreement with the average experimental visibility data and still gives the same wave-length center of gravity for light of a color temperature of 2,077 deg. K. as is given by Ives' physical photometer solution. —*Scientific Paper No. 475 of the Bureau of Standards.*

Motors and Control

Mine-Hoist Control Equipment for Large Installations.—H. W. CHADBOURNE.—Advantages of the Ilgner-Ward Leonard system, high-efficiency hoisting apparatus, automatic control features and the auxiliary hoisting motors are among the more important features discussed in this article.—*Coal Age*, Nov. 1, 1923.

First All-Electric Steel Plant in Brazil.—N. A. V. PAULSSON.—The first all-electric steel plant in Brazil was recently placed in operation. This installation utilizes 5,000 kva. in the iron and steel plant, but a 12,000-kva. power station is being built so that extensions may be made later. A general description is given of the ore supply, electric pig-iron furnace, iron smelting, steel making, rolling mill and various other electrical features. The equipment now installed with the rating of each is given in the accompanying table.—*Bulletin of the Pan-American Union*, November, 1923.

ELECTRICAL EQUIPMENT FOR BRAZILIAN STEEL PLANT

	Rating, Kva.
Two Swedish type furnaces, one stand-by	3,000
Two 6-ton bessemer converters (blowing engine for one)	700
One 6-ton Ludlum steel furnace	1,500
One 16-in. rolling mill	500
One 10-in. rolling mill	500
Miscellaneous 220-volt power for motors, cranes, shops and lighting	400
Total	6,600

Electrical Equipment of Sand and Gravel Dredges.—J. E. BORLAND.—Two dredges of the ladder or bucket type that have been in successful operation for more than a year and that are completely electrified are described.—*Electrical Journal*, November, 1923.

Heat Applications and Material Handling

Automatic Conveying in Material Handling.—L. S. LOVE.—Vertical units and various types of horizontal conveyors that are in intensive use at the National Cash Register works are described. Control equipment and motor drive are considered.—*Iron Age*, Oct. 25, 1923

Factors Entering Into the Selection of Motors for Mine Hoists.—F. W. CRAMER and A. A. MACDONALD.—Frequently in the selection of a hoist the first cost has a direct bearing on the buying of equipment. The cost of power often influences the style and type of drive purchased. In a mine completely electrified the authors believe that a 1,000-hp. hoist motor has no appreciable affect on the demands when central-station power is purchased. Complete electrification means greater production and lowest cost of coal per ton mined. The straight induction motor, water rheostat control and the Ward Leonard motor-generator system are the typical hoist drives. The induction motor represents the lowest investment cost, but the starting demands are high. With the second system the demand peak is reduced about 15 per cent, while with the motor-generator set the demand peak is cut to one-half or one-third that of the induction motor, but the cost of the equipment is about two and one-half times as great. As the energy consumed per ton of coal by the induction motor is always the same for the same installation, this system is more efficient when the output of the mine is cut down by slumps, car shortage, etc. With the motor-generator set the energy consumed is variable, depending on the rate of use.—*Proceedings of Association of Iron and Steel Electrical Engineers*, October, 1923.

Electric Lift Trucks for Material Handling.—M. W. POTTS.—The author discusses some of the problems of material handling and shows how they are being solved. In particular he treats of lifting trucks, under which come the tiering, crane, dump body, furnace charging, ram, paper and special load-carrying trucks. There is very little standardization between the various types of trucks on the market for one particular duty. The main difference is in the hoisting mechanism and the location of the elevating motor drive and control.—*Industrial Management*, October, 1923.

Electrophysics, Electrochemistry and Batteries

Electricity in Flames.—H. A. WILSON.—A concise review is given of the present state of the knowledge of the subject, followed by a bibliography. The paper includes early observations, conductivity of salt vapors in flames, ionic mobilities, flames in a magnetic field, charge carried by the ions of salt vapors at high temperatures, conductivity of flames for rapidly alternating currents and thermodynamical theory of ionization at high temperatures.—*Paper presented before the American Electrochemical Society at Dayton, Ohio*, Sept. 27-29, 1923.

Positive Ion Currents in the Positive Column of the Mercury Arc.—I. LANGMUIR.—Negatively charged electrodes in the path of a mercury arc take up a current which is bound to be independent of the impressed voltage. The author, starting with this phenomenon, arrives at a theory which not only explains this fact but also gives a new conception of the nature of the mercury arc.—*General Electric Review*, November, 1923.

Traction

Savings from Paulista Electrification Estimated.—S. B. FORTENBAUGH.—The costs of electric and steam operation over a period of five years are analyzed on this important main-line railway in Brazil. Electrification is expected to save as high as 65 per cent of the total operating cost, of which fuel is a major factor.—*Electric Railway Journal*, Nov. 3, 1923.

Electrification of Foreign Railways.—S. PARKER SMITH.—In the third article of this series on railway electrification the author deals with the developments which are taking place in Scandinavia. In this country the problem is intimately bound up in the utilization of the water-power resources. The coal fields of Sweden are of small extent and their products not suitable for locomotive use, so that in addition to a purely economic consideration in the use of water power for electrification there is the allied consideration of economic independence of imported coal. A discussion of the various methods of electrification in use is given.—*Beama (England)*, November, 1923

Miscellaneous

Electric Irrigation Plant at Los Almadenes, Spain.—H. DESBARRES.—The fertility of the regions of Murcie and Alicante on the west coast of Spain depends largely upon profuse artificial irrigation, made possible by an elaborate canal system which dates back to Moorish times. To supplant the decentralized and extremely inefficient ancient irrigation wheels in this section, a modern electric pumping system has recently been put in service. The entire territory of about 40,000 hectares requires more than 7,000 liters of water per second, which calls for a pumping energy of over 6,000 hp. A hydro-electric power station was erected at Los Almadenes, on the River Segura, operating under a head of 47 m. Three horizontal-shaft Francis-type turbines of 4,200 hp. and 500 r.p.m. drive 3,500-kva., 5,000-volt, 50-cycle, three-phase generators, the voltage of which is stepped up to 65,000 by a bank of three 3,700-kva. single-phase transformers. The transmission line, of a total length of 137 km., is supported on steel towers, spaced on the average 100 m. apart, equipped with American pin-type insulators. A Petersen grounding coil is placed at the Y-point of the 65,000-volt bus system. Six substations are distributed along the irrigation canals, reducing the transmission voltage to 5,000 for the operation of induction motors, driving direct-coupled centrifugal pumps. Depending on delivery and head, two types of pumps are used, namely, 220-hp. sets for 1,700 liters per second and 6.8 m. elevation, and 650 hp. for 1,500 liters per second and 25 m. elevation. The pumps are horizontal-shaft Sulzer types, running at 585 r.pm. and 740 r.p.m. respectively.—*Revue Générale de l'Electricité*, Sept. 29, 1923.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Topics at the Capital

Surveying Muscle Shoals Power Market—Tri-State Treaty—Niagara and Barge Canal

A SURVEY of the power market in the region tributary to Muscle Shoals is being made by the federal government. The Department of Commerce, the Ordnance Department and the Federal Power Commission are participating. Apparently this information is being gathered to enable the government to calculate the value of a lease, should it be decided to handle the Muscle Shoals proposition on such a basis. A bill is to be introduced early in the new Congress to provide that the leasing of power at Muscle Shoals must be conducted under the provisions of the water-power act. A number of government officials have accepted the invitation of Col. Hugh Cooper to visit Muscle Shoals as members of the party which will examine the project in the week of Dec. 10.

The Secretary of War has suggested the advisability of permitting representatives of the Corps of Engineers and of the Federal Power Commission to participate in the early discussions of the proposed treaty between New York, New Jersey and Pennsylvania as to the utilization of the resources of the Delaware River. Since any compact into which these states might enter affects matters within the jurisdiction of those agencies, Secretary Weeks believes it would be well to have the general commission acquainted with the exact jurisdiction of the federal government in connection with the utilization of the Delaware River.

DISPUTE OVER BARGE CANAL WATER

Measurement of the water passing through the New York State Barge Canal is to be undertaken to determine whether or not water in excess of the amount needed for navigation is being diverted from the Niagara River. The work will be done by the measuring commission recently appointed to represent the United States and Canada, of which the American member is Major P. S. Reinicke, the district engineer in charge at Buffalo for the Corps of Engineers. W. M. Stewart represents Canada.

It is contended by representatives of the federal government that no water is being diverted through the canal over and above the requirements for navigation, although in issuing a license to the Niagara Falls Power Company it was assumed that 500 cu.ft. per second of treaty water was going through the canal. Certain interests in Lockport and Medina have laid claim to the right to use this 500 second-feet of treaty water and have applied to the Federal Power Commission for a license to cover its use. Those interests hold a revocable state permit which recites their right to have this amount of treaty water transported through the canal as far as Lockport.

If it is found that no treaty water is being transported through the canal, it is assumed that the Federal Power Commission will license the 500 second-feet for diversion at the Falls. Even in that event it is understood that the Niagara Falls Power Company is willing to remunerate the holder of the state license for any equity which he may possess.

Ottawa Official Talks of Increasing Niagara Diversion

A dispatch from Ottawa quotes the Canadian Minister of the Interior, Charles Stewart, as saying that if power requirements continue to increase at their present rate it will compel a reconsideration on the part of the four parties to the power treaty —the United States, New York State, Canada and Ontario—of the diversion limitations provided in that pact.

"There is no serious concern felt here," said Mr. Stewart, "but our experts are now engaged in making measurements on both sides of the Niagara River to determine the amount of water now being used for power purposes, and it is inevitable that if the present situation becomes aggravated for any considerable period the treaty limitations will have to be reconsidered."

Stock-Selling Campaign in Colorado Far Past Mark

Henry L. Doherty & Company report that during a ten-day customer ownership campaign just ended which was conducted by the Public Service Company of Colorado 5,545 new stockholders purchased 16,593 shares of stock. This was an average purchase by each new shareholder of 2.99 shares of stock. The success of the campaign, the quota for which was 10,000 shares of 7 per cent preferred stock, was, the Doherty organization says, the result of co-operation and effort on the part of the 1,500 employees of the company, which serves the cities of Denver and Boulder and a large number of smaller towns and villages in Colorado.

Missouri Merger Complete

Commission Authorizes a Newly Organized Company to Acquire Ten Others

EXPANSION of the McKinley-Studebaker utility properties along lines already indicated in these columns has reached another stage through the authorization by the Missouri Public Service Commission of the acquisition of ten operating public utility companies in the central part of Missouri by the newly organized Missouri Power & Light Company of Mexico (formerly the Missouri Utilities Company), whose common stock is owned by the North American Light & Power Company, which is closely associated with the Illinois Power & Light Corporation in the ownership and management of public utility properties in Illinois, Missouri, Iowa, Kansas, Nebraska and Oklahoma.

Public utility service in twenty-four Missouri towns is affected by the deal. These include Mexico, Jefferson City, Boonville and Moberly. Besides the Missouri Utilities Company those absorbed are the North Missouri Light & Power Company, Jefferson City Bridge & Transit Company, Jefferson City Light, Heat & Power Company, Boonville Light, Heat & Power Company, Citizens' Electric Company, Huntsville Light & Power Company, Adair County Light, Power & Ice Company, La Plata Light, Heat & Ice Company and the Moberly Light & Power Company.

Officials of the North American Light & Power Company at Chicago say that arrangements have been made with Chicago and New York bankers to finance the reorganization.

Another purchase just announced by the Illinois Power & Light Corporation is that of the Monmouth (Ill.) Public Service Company.

Denied that Control of Kansas City Company Has Passed

Purchase by the Illinois Power & Light Corporation of the Armour common stock holdings in the Kansas City Power Securities Corporation, which owns all the capital stock of the Kansas City Power & Light Company, is confirmed. This, however, does not carry with it control of the company, according to Joseph F. Porter, president of the Kansas City company and of the Kansas City Power Securities Corporation, who says that Mr. Armour's stock was only about 26 per cent of the total.

Changes in Wisconsin Code

Many of Interest to Engineers and Operators Undergo Consideration at Milwaukee

PREPARATORY to printing a second edition of the Wisconsin Safety Code, supplies of which are now exhausted, the advisory committee of the Railroad Commission of Wisconsin, with C. B. Hayden as chairman, held a meeting in Milwaukee on Nov. 22 at which various proposed changes in the code were brought up for consideration. As pointed out by Mr. Hayden before the meeting started, it is the desire of the committee to consider only minor changes in the code or others of greater importance which are made imperative by changed conditions. He expressed the opinion that radical changes not made necessary so far by experience should be postponed to a later time so that they can have adequate consideration.

It developed in the discussion, however, that some of the proposed changes, even though in fair compliance with the National Safety Code, differed radically from the present Wisconsin State Electrical Code, and these subjects have been referred to sub-committees for further consideration with the hope that some agreement can be reached in time to include them in the new code. If this agreement is not reached, it is quite likely that the changes will be postponed.

OTHER CHANGES PROPOSED

Less than 25 per cent of the proposed changes could be gone into in the one-day session, and another committee meeting, possibly about Dec. 12, will have to be held if all of the proposed changes are to be considered. Of the changes considered, those which aroused the greatest discussion and difference of opinion were the ones affecting who should provide ground for services to power apparatus, whether ground wires should be run in metal conduit or not, the clearance between wires and buildings, and what electrical apparatus should be allowed inside motion-picture booths. Other proposed changes which may arouse discussion concern the identification of terminals, the question whether conductors larger than No. 8 A. W. G. should be identified, the desirability of requiring disconnecting switches for all motor starters, the proximity of control apparatus to the apparatus controlled, a limitation on the connecting of motors direct to lines without starters, the desirability of intrducing exception to requirements for fuses or circuit breakers in industrial plants when changes are made in conductor size under certain conditions, the advisability of requiring switches on the load side of cartridge and plug fuses above a certain size, the proposal of dead-front panelboards for lighting distribution centers, and the prohibition of combustible shades on all electric light bulbs regardless of type and wattage.

All interests are very well represented on the advisory committee, and even after new recommendations or proposed changes are made the whole subject of revision of the code will be thrown open to a public meeting before action is taken.

Brooklyn Edison Buys Electric End of Flatbush Gas

Negotiations are under way whereby the Brooklyn (N. Y.) Edison Company will take over the electric distribution system and franchises of the Flatbush Gas Company, and application will soon be made to the New York Public Service Commission for authority for the transfer. The Flatbush Gas Company is owned by the Brooklyn Union Gas Company, and the sale price is $4,500.000. This was announced on Monday by William A. Prendergast, chairman of the Public Service Commission.

The Flatbush company serves consumers in the Flatbush section of Brooklyn, and, according to Mr. Prendergast, the transfer of the electric service to the Brooklyn Edison Company will result in a saving of approximately $250,000 a year to consumers of electric light and power in that section. "If approved," Mr. Prendergast said, "this sale would mean that all the electric lighting business in Brooklyn would be done by the Brooklyn Edison Company, which will avoid the duplication now necessary." He said the change would reduce the base price for electricity now paid by 35,000 users in Flatbush to 8 cents a kilowatt-hour. Small consumers now pay 10 cents a kilowatt-hour.

International Power Scheme Under Way

Plans for the development of export power business between the Province of Quebec and the New England States are said to be approaching maturity. The interests controlled by E. A. Robert, president of the Montreal Tramways Company, are reported behind the plan, which will involve the transmission of about 60,000 hp. across the border.

The plan would result in the disappearance of the Montreal Tramways & Power Company, holding company for the Montreal Tramways, and the formation of a new company, embracing the Quebec-New England Hydro-Electric Corporation and the Canadian Light & Power Company, as well as control of the Montreal Tramways.

The project is said to include the development of 40,000 hp. at Carillon, near Montreal, where the group controls a valuable power site, as well as at Rivière du Loup, 70 miles from Montreal, where 21,000 hp. will be available. Contracts obtained in New England for power will, it is said, form the basis of financing the enterprise. An export license for ten to twenty years has been requested from the authorities at Ottawa.

Electric Accident Policies

A. I. E. E. Discussion at Hartford on Insurance Covering Electric Hazards to Machinery

BEFORE a largely attended meeting of the Connecticut Section of the American Institute of Electrical Engineers held at Hartford on Nov. 22 W. R. C. Corson, vice-president Hartford Steam Boiler Inspection & Insurance Company, outlined the recent development of electrical accident insurance in this country and emphasized the need of further experience in order to determine satisfactory rates for power-plant and electric installations.

In a general discussion which followed the author's historical survey it was brought out that about sixteen companies are now writing engineering insurance in America, about half of these also writing electrical insurance. It is roughly estimated that the total volume of electrical insurance in the United States is about eight million dollars. The past year's experience shows that premiums will have to be increased unless losses can be reduced by inspection and by the co-operation of plant owners and operators. One large company reported that one electrical machine out of thirteen insured was up for a claim of some sort last year, compared with one electrical machine in ten insured in England and one boiler in 250 insured in that country. The first year's insurance against engineering breakage is apt to be disastrous in total claims involved as compared with later periods.

The importance of more closely defining "fire" in the insurance of electrical machinery against loss was brought out in the discussion. There have been disagreements between casualty and fire insurance companies as to mutual liability for damages in turbo-generator burn-outs, for example. In one case it cost $8,000 to rewind a 30,000-kw. generating unit, the winding of which had been damaged by internal overheating, resulting in the destruction of insulation. This was accompanied by smoke, but the fire insurance interests argued against sharing in the damages on the ground that the accident was not a fire in the accepted sense. The courts held otherwise, and all the insurance interests shared the loss.

STANDARDIZING INSPECTIONS

A. D. Colvin general manager Hartford Electric Light Company, pointed out the opportunities for standardizing inspections covering the same plant. In a typical case two inspectors went over the same plant and the reports and recommendations differed radically. Each list of points presented had merit, but there was not the concurrence of view that would have been expected. Much depends, the speaker said, upon the use made of insured machinery, some equipment held chiefly for reserve service deserving a different rating in regard to premiums from the more modern apparatus.

H. W. Derry, power engineer Hartford Electric Light Company, pointed out that the attention of all purchasers of motors is drawn to the value of breakdown insurance, and as a result the insurance taken out in many cases has helped materially in weeding out operating troubles. It was brought out that where a process involving large values in product or critical treatment is dependent upon a single small motor, the provision of an extra motor represents a highly satisfactory insurance against interruptions of production.

Joseph Sachs, electrical engineer, Johns Pratt Company, Hartford, touched upon the interdependence of electrical equipment and circuits and the importance of defining the limits of coverage in insuring against accidents.

Transatlantic Radio Makes a New Stride

For the first time in the history of radio, transatlantic broadcasting on a liberal scale was carried out last Sunday, when piano music rendered in England and exclamations of greeting from Liverpool, Manchester, Glasgow, Cardiff and other British cities were distinctly heard in the Atlantic Coast States. Every broadcasting station in the United States by prearrangement became silent at 10 o'clock, Eastern standard time, equivalent to 3 a.m. in London, while radio receiving apparatus the country over began listening for England.

Had there not been interference from San Antonio and Chicago the results, it is held, would have been even more successful. As it was eight official British stations and one independent attempted successfully for thirty minutes to establish group communication. A darkened ocean, chosen as more favorable than daylight, and air that for at least part of the time was hushed from coast to coast aided the accomplishment.

Calls on Maine to Abandon Water-Power Policy

A call to the people of Maine to take action to end the present impasse regarding the non-exportation of power from the state and to encourage hydro-electric development for interconnection purposes was sounded by Clarence C. Stetson of Bangor, Me., on Nov. 22, in an address before the Bangor Chamber of Commerce. Mr. Stetson served during the past two years as secretary of the Colorado River Commission and was recently an assistant of Secretary of Commerce Hoover. Declaring that the present is a critical period for Maine in view of the prospective development of superpower in neighboring Atlantic Coast states, the speaker emphasized the economic benefits to the state and its people which would result from the exportation of surplus hydro-electric and steam-plant energy. He termed the retention on the statute books of the law forbidding the transmission beyond the confines of the state of hydro-electric energy on the plea that Maine will require all the power for her own uses and that industries will thus be forced to go there a "most striking instance of sectionalism and individualism."

The speaker pointed out that existing power developments are small and relatively uneconomical compared with those which might be developed to conform to superpower and interconnection requirements, with exportation of surplus power. There is today in Maine, he said, 500,000 installed horsepower and about 700,000 hp. awaiting development. Assuming an increase of 125,000 hp. to be needed by Maine up to 1932, there would still be a surplus of 575,000 hp. which could be marketed. Maine, said Mr. Stetson, cannot afford to remain isolated from superpower development. Capital will not seek investment in her water power on the needed scale until a definite and constructive policy is established by the state. Development and exportation of power, he declared, would mean $100,000,000 of new wealth distributed chiefly among the citizens of Maine, $1,500,000 in new taxes annually distributed in Maine and $12,000,000 in new revenue annually in circulation.

November Yield Advances to 6.49 per Cent

NEW bond, note and stock issues of electric light and power companies offered during the month of November amounted to $56,672,000, a total representing a decrease of more than seven million dollars under the preceding month's total and an increase of more than six million dollars over the total of November, 1922. The rate of return yielded the investor advanced considerably, from 6.25 in October to 6.49, the second highest average yield of the year. The larger offerings of the month included an issue of $10,300,000 in gold bonds of the Penn Central Light & Power Company offered at 98 and yielding 6.15 and a ten-million-dollar issue of Northern States Power Company gold notes offered at 98½ and yielding 6.70. Long-term securities prevailed.

SECURITY ISSUES OF ELECTRIC SERVICE COMPANIES IN NOVEMBER

Name of Company	Amount of Issue	Period, Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Penn Public Service Corp.	$2,500,000	24	First and refunding mortgage gold bonds, series C	Construction	6	98¼	6.13
Electric Bond & Share Co. (N. Y.)	2,400,000	..	Cumulative preferred stock	General corporate purposes	6	97½	6.15
Nevada-California Electric Corp. (Cal.)	1,000,000	27	First lien gold bonds, series B	Construction	6	94	6.45
Bartlesville Gas & Electric Co. (Okla.)	246,000	24	First mortgage sinking-fund gold bonds	New capital	6	93.96	6.50
Mississippi Power & Light Co.	1,200,000	20	First and refunding mortgage sinking-fund gold bonds, series A	Additions, refunding and other corporate purposes	6½	94½	7
Illinois Power & Light Corp.	5,000,000	30	First and refunding mortgage gold bonds, series A	Additions	6	98½	6.10
Tennessee Electric Power Co.	1,000,000	10	Debenture bonds	Additions and to increase working capital	6½	96	7.05
Ohio River Edison Co.	3,000,000	..	Cumulative guaranteed preferred stock	Additions	7	93½	7.50
Pennsylvania Water & Power Co.	2,000,000	30	First refunding mortgage gold bonds, series A	Construction and other corporate purposes	5½	95½	5.80
Penn Central Light & Power Co.	10,300,000	30	First and refunding mortgage gold bonds	Refunding and additions	6	98	6.15
Pennsylvania-Ohio Electric Co. (Ohio)	250,000	15	First mortgage and collateral trust sinking fund gold bonds, series B	..	6½	100	6.50
Ohio Public Service Co.	2,400,000	30	First mortgage and refunding gold bonds, series C	Construction	6	94½	6.40
Utica Gas & Electric Co. (N. Y.)	500,000	..	Cumulative preferred stock	Additions	7	102	6.86
Sioux City Gas & Electric Co. (Iowa)	300,000	..	Preferred stock	Additions	7	100	7
Northern States Power Co. (Minn.)	10,000,000	10	Convertible gold notes	Refunding and to reimburse for expenditures	6½	98½	6.70
West Penn Co.	4,000,000	..	Cumulative preferred stock	Additions and other corporate purposes	7	89½	7.80
Minnesota Power & Light Co.	8,300,000	27	First and refunding mortgage gold bonds	Construction	6	97½	6.15
Kansas Power Co.	500,000	10	Sinking-fund gold debenture bonds	..	7	99½	7.05
Indiana Service Corp.	500,000	27	First and refunding mortgage bonds, series A	Additions	5	86½	6
Indiana Power Co.	450,000	..	Cumulative participating preferred stock	Additions	7	90	7.78
Appalachian Power Co. (W. Va.)	826,000	18	First mortgage bonds	Reimburse for addition to property	5	90½	5.85
Total	$56,672,000						

Central Stations Spending Half Billion

Large Power Houses and Extensions Now Under Way Will Have Rating of 4,595,675 Kva.—Sixty-four of These Installations Are Steam and Fifty-two Hydro

THE tabulation below gives the chief electric power stations and extensions now under way in the United States. The figures, though not exact in every case, are believed to be a reasonably close approximation. A total expenditure of $536,708,750 is indicated. Although a few large municipal and industrial developments are included in this total, innumerable small installations are not recorded, and it is evident that the amount now being spent by the electric light and power companies of the United States to increase their output is much over half a billion dollars. Sixty-four of the plants included in the table are steam and fifty-two are hydro-electric, the steam plants having a total rating of 3,052,850 kva. and the hydro-electric plants of 2,057,100 hp., equivalent to 1,542,825 kva.

The biggest steam installation under way is that of the Philadelphia Electric Company (270,000 hp.). The 250,000-kva. installation of the Public Service Electric Company at Kearny, N. J., is another large individual steam installation, and the Commonwealth Edison Company is installing a total of 227,000 kva. in two of its Chicago stations. The Detroit Edison Company, with 150,000 kva., is fourth. The largest hydro-electric installation is that of the Niagara Falls Power Company (210,000 hp.). Three other hydro-electric plants reach the 100,000-hp. mark.

As would be expected, the Middle Western States take the first place in kva. of steam installations, with the Northern Atlantic Coast States next, while the Pacific and Mountain States lead in water power. The total for the Southern States, however, is also high, showing that construction activity prevails in every section of the country.

Cincinnati Company Seeking Site for Big Plant

Within the next thirty days a decision will be reached by the Union Gas & Electric Company of Cincinnati as to the location of an electric generating plant, to cost between $12,000,000 and $15,000,000. This statement was made last week by President W. W. Freeman of the company. This generating station, which will be erected

Power Stations and Extensions Now Under Way

(As recorded in the "Electrical World" Up to Dec. 1, 1923)

STEAM STATIONS

Company	Plant	Initial Kva.	Ultimate Kva.	Date of Operation
Abilene (Kan.) Gas & Electric Co..	Abilene	3,700	.....	1923
Adirondack Power & Light Corporation (N. Y.)	Amsterdam	*30,000	.....	1924
Brooklyn Edison Co. (N. Y.)	Hudson Avenue	62,500	.....	1924
Central Power Co. (Neb.)	Grand Island	3,750	.....	1923
Cleveland Electric Illuminating Co.	Lake Shore	*70,000	.....	1923
Commonwealth Edison Co.	Calumet	*67,000	.....	1923
Commonwealth Edison Co.	Crawford Avenue	160,000	600,000	1924
Connecticut Light & Power Co.	Devon	75,000	150,000	1923
Consolidated Light, Heat & Power Co. (W. Va.)	Kenova	15,000	.....	1924
Consumers' Power Co. (Mich.)	Zilwaukee	50,000	10,000	1923
Danville (Ill.) St. Ry. & Lt. Co.	Danville	7,500	.....	1924
Denver Gas & Electric Light Co.	Boulder	90,000	90,000	1923
Detroit Edison Co.	Trenton Channel	150,000	.....	1924
Detroit Municipal Plant	Detroit	80,000	.....	1925
Duquesne Light Co. (Pa.)	Colfax	*70,000	.....	1924
East Penn. Electric Co. (Pa.)	Pine Grove	50,000	300,000	1923
East St. Louis Light & Power Co.	Cahokia	60,000	240,000	1923
Edison Elec. Ill. Co. of Boston	Weymouth	62,000	300,000	1923
Empire District Electric Co (Kan.)	Riverton	20,000	.....	1923
Fort Dodge Gas & Elec. Co. (Iowa)	Fort Dodge	15,000	.....	1923
Houston Ltg. & Pwr. Co. (Tex.)	Deepwater	40,000	160,000	1924
Illinois Electric Power Co.	Peoria	53,300	133,000	1925
Illinois Power & Light Co.	Venice	*20,000	.....	1924
Indiana Electric Corp.	Wabash	40,000	100,000	1924
Indiana General Service Co.	Marion	*10,000	.....	1923
Indiana & Michigan Electric Co.	South Bend	60,000	300,000	1925
Iowa Railway & Light Co.	Cedar Rapids	10,000	.....	1923
Kansas Gas & Electric Co.	Service City	60,000	.....	1924
Kentucky Utilities Co.	Pineville	30,000	.....	1924
Louisville Gas & Electric Co.	Louisville	*20,000	.....	1923
Metropolitan Edison Co. (Pa.)	Middletown	30,000	200,000	1924
Middle West Power Co. (Ill.)	Grand Tower	25,000	100,000	1924
Montaup Electric Co. (Mass.)	Fall River	30,000	150,000	1924
New York Edison Co.	Waterside	*30,000	.....	1923
Northern States Power Co.	High Bridge	80,000	120,000	1924
Northern States Power Co.	Riverside	*30,000	90,000	1926
Northern States Power Co.	Sioux Falls	*10,000	.....	1924
Northern States Power Co.	Fargo	*4,000	.....	1923
Ohio Power Co.	Philo	60,000	300,000	1924
Oklahoma Gas & Electric Co.	Harrah	15,000	.....	1924
Oklahoma General Power Co.	Muskogee	*10,000	.....	1923
Penn. Central Power Co. (Pa.)	Saxton	25,000	80,000	1924
Pennsylvania-Ohio Edison Co.	Toronto	66,000	240,000	1924
Philadelphia Electric Co.	Delaware	*60,000	.....	1923
Philadelphia Electric Co.	Delaware River	270,000	600,000	1926
Public Service Co. of Northern Ill.	Joliet	*30,000	.....	1923
Public Service Co. of Northern Ill.	Waukegan	25,000	250,000	1923
Public Service Electric Co. (N. J.)	Jersey City	25,000	.....	1923
Public Service Electric Co. (N. J.)	Kearny	250,000	500,000	1925
Public Service Electric Co. (N. J.)	Essex	*99,900	.....	1924
Sand Springs (Okla.) Pwr. & Lt. Co.	Sand Springs	*12,000	.....	1923
Sioux City Gas & Elec. Co. (Iowa)	Sioux City	20,000	.....	1924
Southern Colorado Power Co.	Pueblo	*7,500	.....	1923
Southern Power Co.	Mount Holly	40,000	.....	1924
Southern Power Co.	Eno	20,000	.....	1924
Tennessee Electric Power Co.	Nashville	*12,500	.....	1923
Tennessee Electric Power Co.	Hales Bar	40,000	.....	1924
Topeka Edison Co. (Kan.)	Topeka	15,000	.....	1924
Tri-City Railway & Light Co. (Ill.)	Moline	*26,000	.....	1924
Union Gas & Electric Co. (Ohio)	Cincinnati	*30,000	.....	1926
Union Lt., Ht. & Pwr. Co. (N. D.)	Fargo	4,000	.....	1924
United Elec. Lt. & Pwr. Co. (N. Y.)	Hell Gate	*70,000	.....	1923
United Light & Railways Co.	Davenport	26,000	150,000	1924
West Penn Power Co.	Springdale	*70,000	.....	1924
Total kva.		3,052,850		

HYDRO-ELECTRIC STATIONS

Company	Plant	Initial Hp.	Ultimate Hp.	Date of Operation
Alabama Power Co.	Coosa River	120,000	120,000	1923
Alabama Power Co.	Mitchell Dam	75,000	120,000	1923
Alabama Power Co.	Tallapoosa	88,000	132,000	1925
Arkansas Light & Power Co.	Ouachita	15,000	120,000	1924
Blue Ridge Power Co. (N. C.)	Turner Shoals	10,000	.....	1924
Dixie Power Co.	White River	50,000	160,000	1926
Eastern Iowa Power Co.	Pinhook	1,800	.....	1923
Empire District Electric Co. (Kan.)	Table Rock	60,000	.....	1925
Farmington River Hydro. Corp. (Conn.)	New Boston	7,600	.....	1925
Feather River Power Co. (Cal.)	Bean Creek	62,000	202,000	1925
Georgia Railway & Power Co.	Mathis	15,000	.....	1924
Georgia Railway & Power Co.	Tugaloo	60,000	.....	1924
Georgia Railway & Power Co.	Bull Shine	*5,000	.....	1925
Georgia Railway & Power Co.	Leeds	6,000	.....	1925
Georgia Railway & Power Co.	Burton	6,000	.....	1926
Georgia Railway & Power Co.	Tugaloo and Tallulah	30,000	.....	1926
Great Western Power Co.	Caribou	30,000	180,000	1924
Idaho Power Co.	Snake River	*20,000	.....	1923
Indiana Hydro-Electric Co.	Norway	2,500	9,000	1923
International Paper Co. (N. Y.)	Sherman Island	30,000	.....	1923
Kentucky Hydro-Electric Co.	Dix River	25,000	.....	1924
Lake Superior District Power Co.	Flambeau	16,000	.....	1925
Los Angeles Municipal Plant	San Francisquito	*16,000	.....	1924
Louisville Electric Co.	Falls of Ohio	75,000	.....	1926
Minnesota Light & Power Co.	Jim Falls	16,000	.....	1923
Modesto-Turlock Irr. Dist. (Cal.)	Don Pedro	15,000	.....	1923
Montana Power Co.	Mystic Falls	15,000	.....	1924
New England Power Co.	Davis Bridge	40,000	.....	1923
Niagara Falls Power Co.	Niagara	*210,000	.....	1923-4
Northern States Power Co.	High Bridge	80,000	106,000	1925
Northern States Power Co.	St. Croix Falls	*9,000	.....	
Pacific Gas & Electric Co.	Pit No. 3	90,000	.....	1925
Pacific Power & Light Co.	Hood	8,700	.....	1923
Pacific Power & Light Co.	Deschutes	40,000	40,000	1926
Pennsylvania Power & Light	Hawley	50,000	.....	1925
Pennsylvania Public Service Corp.	Clarion River	25,000	260,000	1923
Pennsylvania Water & Power Co.	Holtwood	*40,000	.....	1924
Portland Railway & Light Co.	Oak Grove	25,000	100,000	1924
Portland Railway & Light Co.	Clackamas River	35,000	105,000	1924
Roosevelt Dam Project	Salt River	*7,000	.....	
San Francisco Municipal Plant	Hetch Hetchy	100,000	100,000	1924
Seattle Municipal Plant	Skagit	40,000	70,000	1923
Sierras Power Co.	Leevening Creek	*14,000	.....	1923
Southern California Edison Co.	Big Creek No. 3	108,000	210,000	1923
Southern Power Co.	Mount Holly	80,000	.....	1923
Southern Power Co.	Great Falls	60,000	.....	1923
Southern Power Co.	Catawba	50,000	.....	1924
Southern Sierras Power Co.	Mill Creek	3,000	.....	1924
Tennessee Electric Power Co.	Great Falls	22,200	.....	1924
Utah Power & Light Co.	Bear River	18,800	.....	1924
Washington Water & Power Co.	Oroville	*2,500	.....	1923
Western States Gas & Elec. (Cal.)	Eldorado	27,000	100,000	1924
Total hp.		2,057,100		

TOTAL RATINGS AND ESTIMATED COST OF POWER HOUSES AND EXTENSIONS UNDER WAY

Steam (64 installations), 3,052,850 kva., at $100 per kva.	$305,285,000
Hydro-electric (52 installations), 1,542,825 kva., at $150 per kva.	231,423,750
Total estimated cost of stations and extensions under way	$536,708,750

* Extensions.

near Cincinnati at some point where advantage of the company's coal properties may be taken, will be the main source of the electrical energy with which the company is to supply Cincinnati, Hamilton, Middletown and northern Kentucky cities, deriving their light and power from the present plants of the Columbia Gas & Electric Company and Union Gas & Electric Company.

If the plant is placed in close proximity to the coal mines the coal from these mines is to be burned at their mouths instead of shipping it by barge and trainload to the present plants of the company. The proposed superpower plant, it is said, will take the place of the plants now in operation in Cincinnati and elsewhere, though these are to be retained as standby stations in case of accident to the trunk transmission lines. Mr. Freeman says that one of the company's several optional sites will be selected within thirty days, or before the end of the year.

Southeast, Too, for Pleasing the Public

This Theme Provides the Keynote for the Tampa Convention—Recommendations for Fruitful Publicity—Technical, Commercial and Accounting Sessions

ADVOCACY of improved relations between the central-station industry and the public, which has characterized so many recent National Electric Light Association gatherings, proved also to be the outstanding feature of the general sessions of the eleventh annual convention of its Southeastern Geographic Division, held at the Hillsboro Hotel, Tampa Fla., on Nov. 19 to 22.

Second only to the necessity for cordial relations between the utility companies and the public came the subject of co-operation between the various branches of the industry. This phase was particularly emphasized by F. M. Feiker, operating vice-president of the Society for Electrical Development, and L. W. Davis, general manager of the Association of Electragists International.

Reporting on the public relations committee work in the past year, P. S. Arkwright, chairman, brought out the fact that nearly every company heard from in the Southeast is active in new business and good-will advertising and that most of the advertising appropriations are going into newspaper display with a scattering here and there of billboard and motion-picture advertising, direct-by-mail advertising being utilized by the majority of companies to supplement their newspaper space. It was the opinion of the committee that newspaper advertising is bringing the best results, billboards falling into second place, motion-picture advertising coming third and direct-by-mail advertising last of all.

EIGHT RECOMMENDATIONS

The report outlined in detail the activities of the section during the past year and closed with definite recommendations to the incoming administration, the outstanding recommendations being (1) that all utility companies increase their advertising appropriations; (2) that wherever it is possible to do so public utilities organize and maintain a department of public relations; (3) that newspapers be considered the most desirable medium of advertising; (4) that the work of the women's committee on public information be encouraged in every possible way; (5) that co-operation between the individual companies and the state committees on public utility information be encouraged and that steps be taken to organize state committees in all states in the Southeastern Division; (6) that steps be taken to encourage closer co-operation between manufacturers and jobbers and central stations; (7) that public speaking and safety work be encouraged in every way possible; (8) that more attention be paid to the relations between employees and the public, and that the employees be kept fully informed as to the problems of the company through talks by department heads, employees' meetings or company publications.

Miss Elizabeth Lee, division chairman of the women's committee, voiced an encouraging note when she said that virtually all of the women employees of the various companies were interested and only wished for an opportunity to enter actively into public relations work.

The work of the state committees on public information was sketched by Ross Murphey of the Tennessee committee, who submitted a detailed report of the activities of information bureaus now functioning in the Southeast. H. T. Sands, chairman of the National Public Relations Section, spoke on "Public Relations—What? Why?"

George F. Oxley discussed the publicity plans of the national association, calling attention to good results obtained and urging member companies to keep actively behind their publicity and public relations work. An outline of the association activities in general was given by M. H. Aylesworth, managing director, who held that central-station companies should make every effort to encourage the use of electricity on farms and in rural districts, even though this service might for the time being have to be given at a loss.

TAXATION AND THE INDUSTRY

Adequate and just tax laws and their relation to the central-station industry, both directly and indirectly, was the subject of an address by A. J. Maxwell of the North Carolina Corporation Commission and the North Carolina Tax Commission. Mr. Maxwell stated that it was only through just and adequate tax legislation that the Southeastern States could hope to become the center of great industrial development and that the public must not cripple the industry and prevent its expansion through a short-sighted policy of overtaxing this most important branch of modern business life.

Safety work was ably handled by Charles B. Scott, chairman of the national safety committee, and W. R. Loyd, Southeastern division chairman.

The interconnecting power systems of the Southeast were described in detail in a paper by H. M. Atkinson, chairman of the board of directors of the Georgia Railway & Power Company, in which he outlined concisely the wonderful asset that the present interconnection of the large Southeastern companies has been to that section. Instance after instance was adduced where shutdowns of industrial plants were averted by the ability of the power companies to obtain the necessary supply of energy from sections in which there was a surplus. Mr. Atkinson stressed also the additional economy in the operation of these power companies that inevitably resulted from interconnection.

Speaking from the viewpoint of the public, R. Hudson Burr, Chairman of the Florida Utilities Commission, said that courtesy and tact on the part of employees constitute the most valuable asset of the industry today. He emphasized the need and sound policy of the regulation of all utilities, asserting that only through such regulation by state bodies could justice be done both to the public and to the utilities.

THE SECTION MEETINGS

Commercial Section activities proved to be of unusual interest. In a paper by I. H. Morehead entitled "The Electric Range as a Revenue Builder" monthly energy consumption and other operating conditions were outlined, and J. S. Sutherland's report for the Appliance Bureau, outlining the methods of appliance sales work in the smaller communities of the Southeast, attracted considerable attention.

Samuel A. Chase of the Westinghouse Electric & Manufacturing Company spoke on "Selling the Electrical Idea to the Public."

Among the other subjects covered at the commercial meetings were "Training Salesmen," by M. L. Pierce of the Hoover Suction Sweeper Company, the report of the Power Sales Bureau by H. B. Whiteman, and "Industrial Heating," by P. E. Shacklett.

No little interest was aroused by the Technical Section papers on "Carrier-Current Telephony for Power Systems," by C. C. Jackson of the Westinghouse Electric & Manufacturing Company; "Lightning-Arrester Grounds," by H. M. Towne of the General Electric Company; "Carrier Systems from the Standpoint of Co-ordination," by H. S. Osburn of the American Telephone &

Telegraph Company; "Our Neighbors on the Highway," by K. L. Wilkinson of the American Telephone & Telegraph Company, and "Demand Meters," by W. A. Gentry of the Westinghouse Electric & Manufacturing Company. The latter paper brought out an active discussion.

The Accounting Section's meetings were devoted largely to reports of the budget committee, the committee on classification of accounts and other committees, with a round-table discussion on the various reports.

Following the business sessions, the following officers were elected to serve for the ensuing year: President—T. W. Martin, Alabama Power Company; first vice-president, R. L. Lindsey, Durham (N. C.) Public Service Company; second vice-president, H. C. Foss, Savannah Electric & Power Company, Savannah, Ga.; third vice-president, Howard Hall, Western Electric Company, Atlanta.

The members of the new executive committee will be Charles A. Collier of Atlanta, F. V. Underwood of Birmingham, E. H. Ginn of Atlanta, P. A. Tillery of Raleigh, B. C. Edgar of Chattanooga, Henry Coles of Atlanta, S. M. Cooper of Charleston, A. W. Houston of Palatka, Fla., and W. R. Sammons of Knoxville, Tenn.

Empire State Engineers Meet

Distribution Systems, Joint Line Construction, Underground Network Systems, Overhead Ground Wire, Interconnection and Parallel Operation Discussed

A WELL-BALANCED program presenting vital engineering and operating problems marked the annual fall meeting of the Electric Section of the Empire State Gas and Electric Association, held in Schenectady Nov. 21 and 22. C. H. Ruffner, vice-president and general manager of the Adirondack Power & Light Corporation, after welcoming the association to Schenectady, emphasized the point that the engineers who do the actual technical and engineering work of the central-station industry should aid the public relations committee in meeting the public and informing them what the industry is and what it means to them. These same men should also try to develop an interest in all the departments of the individual company with which they are connected so that, having this broader knowledge, they will not criticise unfairly other departments.

E. P. Peck then explained the plan by which his company, the Utica Gas & Electric, accomplishes this end by means of weekly and semi-weekly conferences of officials of all departments. In these conferences the work that has been done is reviewed and future plans are laid and co-ordinated.

Overhead Distribution

In discussing the essentials of a modern overhead distribution system H. W. Watt, electrical engineer of the Westchester (N.Y.) Lighting Company, declared that a properly built system requires correct design followed by careful construction with good material. Correct design is possible only after a study of the conditions and an application of the best engineering theory and practice. Careful construction requires trained men under intelligent supervision, and good material can best be obtained from reliable manufacturers working under suitable specifications. When laying out a system consideration should be given to the load, its distribution throughout the given area, the load factor, the operating characteristics and the probable growth or change. A definite scheme of procedure should be laid down for a period of ten to fifteen years ahead, with as accurate as possible a predetermination of the extensions and modifications of the system and the year in which these will become operative.

In the discussion following this paper E. P. Peck said that distribution transformers should be built without tops. In regard to automatic substations he thought that there was a very great opportunity for their application to modern systems. This could be done by placing small automatic substations close together with short feeders and operated by supervisory control from the load dispatcher's office.

The suggestion of using a differently colored insulator for the neutral of the four-wire, three-phase system brought forth an animated discussion as to whether this was the best method. C. A. Bacon of the Adirondack Power & Light Corporation favored this plan, while others considered as a better method the running of two phase wires on one side of the pole and the other phase wire and neutral on the other side with neutral toward the pole.

R. A. Paine, Jr., distribution engineer of the Brooklyn Edison Company, said that with pole-type regulators a lot of trouble had been encountered with faulty motors. Mr. Watt thought that this was usually caused by overloading and inadequate inspection and also said that the pole-type regulator should be used only as a temporary method of raising the voltage of part of a line, to be replaced later by an adequate circuit controlled from the substation. The use of this regulator at the end of a rural line was advocated by Mr. Peck when the rural line was part of an urban circuit. This type of circuit occurs when rural customers are first obtained and there is not sufficient load to warrant a new circuit throughout.

An excellent report on the cost of joint-line construction in rural districts was delivered by J. C. Robbins, Albany Southern Railroad Company, and A. W. Underhill, Niagara, Lockport & Ontario Power Company, both members of the rural transmission committee. The paper gave costs on 4,600-volt joint lines and costs on 6,600-volt and 11,000-volt lines under various conditions and types of construction, together with costs on transformer installations. An abstract of this report with the cost tables will appear in a subsequent issue of the ELECTRICAL WORLD.

F. W. Crone, director of the New York State Committee on Public Utility Information, described clearly the work and the purposes of this committee.

C. T. Sinclair of the United Electric Light & Power Company presented a paper giving the features of distribution and transmission systems, particularly of the underground network, of the above company. Practically all of the underground work is at either 7,800 volts or 13,200 volts. After discussing the system layout, relative load density, duct systems and transformer installations he described a method of fault localization. This is accomplished by means of a single-line diagram of a complete circuit, upon which are placed all of the points at which the circuit may be cut apart to determine in what part of the circuit the short circuit has occurred. The use of secondary automatic network switches for clearing short circuits has been found very satisfactory.

Overhead Ground Wire

To determine the prevailing practice and attitude of operating companies toward the use of an overhead ground wire, the transmission line committee, C. A. Bacon chairman, sent out questionnaires to twenty-nine companies in New York State, receiving answers from twenty. Analysis of the answers showed that 37 per cent were in favor of the ground wire, 42 per cent unfavorable, 16 per cent favored it on steel but not on wooden poles, and 5 per cent were uncertain. Nine per cent considered the individual pole lightning rod as effective as an overhead ground wire, 48 per cent did not consider this to be the case and the remainder expressed no opinion.

E. P. Peck asserted that while the ground wire on wooden poles gives electrostatic protection, the burning effect is very serious unless the ground wire is well insulated. He was much against the use of the ground wire on wooden-pole lines but thought that on steel-pole lines it had many advantages. Sydney Alling of the Rochester Gas & Electric Corporation said that on wooden-pole lines with steel arms and ground wire very good operation is obtained.

A valuable paper on high-voltage impregnated-cable specifications, inspections and tests was presented by L. A. Zima of the Brooklyn Edison Company. He described extensive tests made on cables supplied by five manu-

facturers for a voltage of 33,000. Four of these cables tested satisfactorily, while the fifth did not.

WATER-POWER SURVEY

The water-power committee, the chairman of which is F. J. Howes of the Rochester Gas & Electric Corporation, plans to make a survey of seven or eight streams with the aid of the combined companies in central and western New York. Stream-flow data are already available in this area. This data will be plotted with the purpose of ascertaining the diversity between the various streams. Following this the committee plans to make a quantitative survey of this territory, giving the results in dollars and cents.

The New York State interconnection report, presented in its commercial aspects at the Lake Placid convention, was again brought forward by E. P. Peck, chairman, this time in its technical aspects. A general résumé of this report was published, with a map showing transmission systems at 11,000 volts and above in New York, New Jersey, the New England States, Pennsylvania and part of Ohio, in the ELECTRICAL WORLD for Nov. 17. The original report is being published by the association and will be ready in a few days.

W. M. Carpenter, engineer of the Empire State Gas & Electric Association, expressed the opinion that the various state groups working on interconnections in a way similar to that adopted by the Empire State association should be directed and co-ordinated by an N. E. L. A. committee to assure standardization. If this is not done, it is very possible that states in close proximity will eventually have standards varying so widely that interconnection between them will be hampered to a great extent.

Methods of phasing generators and transformers before their operation in parallel with other apparatus were discussed by A. C. Jordan, chairman of the operating committee. As numerous accidents due to improper phasing have been reported, it was the object of the committee to outline a standard method of procedure. Specific instructions with adequate diagrams give the methods of phasing out for generators and tie lines, transformers and stub-end power lines.

H. W. Watt of the Westchester Lighting Company was made chairman of the Electric Section and K. V. Farmer of the Syracuse Lighting Company was made vice-chairman.

Unfinished Georgia Station Helps Out in Drought

During the recent drought in the Southern States half a dozen engineers gathered about one of the huge waterwheels at the half-finished Tugaloo power station of the Georgia Railway & Power Company and threw the generating energy of one unit that had been rushed to completion into the transmission system of the company in aid of its successful effort to keep the industries of Atlanta and other Georgia cities in operation. The plan worked, and 22,000 hp. was added to the company's capacity. As fast as the other units of the new station are completed they will be thrown into the system one by one, and the Tugaloo plant will be unique in that it will be a plant running in full operation some months before it is complete in all details.

A 110,000-volt line was carried from Tugaloo 2½ miles and connected temporarily with the main line at Tallulah Falls. A temporary switch was put in use.

Post Office Continues Work for Better Lighting

Twenty-five Post Office lease inspectors now in Washington from all sections of the country have each been equipped with portable foot-candle meters for measuring illumination, it has been announced by First Assistant Postmaster-General John H. Bartlett, under whose bureau the work is being done. The inspectors in their travels over their districts will study the intensity of the illumination in both new and old buildings and, following their reports, the Post Office Department will take action to bring the lighting of the various offices up to the standard previously established. (See ELECTRICAL WORLD, Feb. 24, page 470.)

Through the use of the instrument the amount of illumination lost because of the aging of the lamp, that lost in passing through the shade or globe, that due to the dirt accumulations, as well as that absorbed by the walls and furniture in the rooms, are accounted for, and an actual measurement of the light at the place where the work is done is obtained. Tests quickly show any change in intensity due to any of these sources.

The equipment of inspectors with the meter is a part of the Post Office Department's policy of providing adequate lighting in all post office buildings so as to assure a maximum of efficiency from employees and at the same time conserve their eyes. For post office work a minimum of 8 ft.-candles to 10 ft.-candles has been established on the basis of studies made by the United States Public Health Service. This standard is to be obtained by general rather than local illumination and will be furnished by a relatively small number of large units installed over the entire working area.

Street-Lighting Tables for 1924

FOLLOWING its practice for thirty-five consecutive years, the ELECTRICAL WORLD has prepared tables showing the proper time for lighting and extinguishing street lamps. The tables for 1924 are now ready, and a copy of them will be sent free to any subscriber upon request to ELECTRICAL WORLD, Tenth Avenue and Thirty-sixth Street, New York. For more than one copy a charge of 25 cents each is made to cover a portion of the postage, printing and compilation costs.

Features of Coming Power Show in New York

Among the salient features of the second national exposition of power and mechanical engineering, to be held at the Grand Central Palace, New York, on Dec. 3-8, concurrently with the annual meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers, will be a complete showing of the latest devices used in measuring the flow, temperature and pressure of fluids and gases. Flow meters for steam, water, air and gas will be shown. In this group one manufacturer will demonstrate the effect of pipe fittings on fluid flow by circulating water at various rates through a section of glass pipe. In another exhibit water pumped through a Venturi meter will be measured by three instruments, two recording and one an indicating manometer, and in addition a special planimeter for obtaining total quantities through the meter from the flow charts will be displayed. One manufacturer will exhibit a V-notch weir meter which records, indicates and integrates the flow of water at a rate of 50,000 lb. of water per hour.

Fuel-oil burners complete with controls and pumps will be displayed by several companies. One exhibitor will show a burner in action spraying water in a glass case. A boiler setting will also be displayed illustrating the method of bricking and connecting the burner and installing the air register. Pulverized-fuel equipment may also be seen and will be of great interest to those who have kept in touch with the recent successful installations that have given high economies and steady performance.

There will also be exhibits of power-transmission devices, including ball and roller bearings for all types of service, self-oiling bearings, accurately cut gears, clutches of all kinds, right-angle transmission and leather and steel transmission belting.

Every manufacturer of refractory material has been bending his efforts to a solution of the problem of producing an economical firebrick for this severe service, and the exhibits will display the results of their efforts. High-temperature insulation in brick block, powder and cement form, air-cooled blocks, clinker-proof blocks and other forms of refractory designed to reduce furnace maintenance, increase furnace efficiency and reduce labor costs will be displayed.

Appraises Coal Reports

George Otis Smith Points Out Their Value and Indicates Where They Fall Short

ADMITTING that only in part are the recommendations contained in the United States Coal Commission's twenty-odd reports broadly or analytically stated, George Otis Smith, director of the Geological Survey and a member of the Coal Commission, said at the annual meeting of the Academy of Political Science in New York on Tuesday, Nov. 20:

"It is none too generous praise to term the commission's reports, made public as yet only in a form primarily for the use of the press, a veritable mine of valuable information, but candor compels the added comment that to prepare the product of this mine for general consumption some sort of a breaker must be provided—it is not enough to dig up raw, crude facts; they must be sized and separated from associated matter of less value.

ABSENCE OF CLEAN-CUT PROGRAM

"The year and more in which the coal problem has had the center of the stage," Mr. Smith continued, "has not sufficed to bring to it the full understanding that is desirable and indeed essential. The continued play of the spotlight has brought out many details, but all the fact finding has not discovered any simple cure-all. This explains the absence of a clean-cut program as the final pronouncement of the Coal Commission; instead, the commission addresses recommendations of remedial action not only to the Congress but to state legislatures and municipal officials, to the Interstate Commerce Commission and to railroad executives, to coal operators and to mine workers, and finally to the great body of coal consumers, large and small. The finding is one of divided responsibility for things as they are and therefore of distributed obligation to make things different.

"With both hard and soft coal, the immediate cause of exorbitant prices has been the demand from buyers at times when the supply has been inadequate. The consumer himself can do much, as the commission recommends, to smooth out the ups and downs of demand by purchasing coal on annual contract and by providing for storage. To encourage the off-season delivery and storage of bituminous coal, the Coal Commission recommends that the Interstate Commerce Commission allow the commercial ability to sell coal the year round to be the controlling influence in the distribution of railroad cars in months of transportation shortage. Economy in the use of transportation by the encouragement of river movement of coal and by the discouragement of long rail hauls is also recommended. Unfair competition by means of unwarranted freight differentials has favored waste of transportation service, both in making improved waterways ineffective and in promoting the premature opening of mines to serve old markets already well supplied from nearer fields. Thus mine capacity has outstripped railroad capacity.

"Irregularity of seasonal demand and unnatural widening of marketing territory, however, are not the only causes of overdevelopment. The opening of too many mines has been a direct result of the uncertainty of continuous operation due to the uncertainty of labor supply. The periodic and anticipated strikes encouraged a higher peak capacity within the organized territory, and as the strikes increased in severity the coal shortage promoted the opening of more mines in the non-union fields."

Dictionary of Specifications in Preparation

Work has been started at the Bureau of Standards, Director Burgess announces, on the compilation of material for a dictionary or handbook of specifications for supplies purchased by federal, state and municipal governments and public institutions. This work grew out of a meeting held in May, 1923, of state purchasing agents from all over the country, at which the co-operation of the various states was assured.

Subsequently a conference was held of various national organizations interested in the preparation and unification of purchase specifications and in their use from the point of view of both the producer and the consumer. This conference was called for the purpose of organizing an advisory committee to co-operate with the Department of Commerce and the national conference of state purchasing agents in the work of formulating purchase standards, specifications and tests. Although no meeting of this advisory committee has yet been held, the various organizations represented are co-operating actively in the actual work of compiling the material for the dictionary, and a great deal of information has been supplied.

Correspondence conducted with the officers of trade associations and the purchasing agents of a large number of municipalities and public institutions has established the fact that all the individuals and groups for which the dictionary of specifications is being prepared will welcome its appearance enthusiastically and co-operate actively in the preparation.

A collection is now being made of all available specifications prepared by the various departments and independent establishments of the federal government and those used by state and municipal governments, public institutions and the important national trade associations and technical societies. These specifications are being thoroughly card-indexed and classified. Care is being taken to pick out those specifications which are most urgently needed, and due consideration is being given to the attitude of purchasers and consumers toward the existing and the proposed specifications.

Brief News Notes

Substantial Increase in Earnings of Electrical Department of New Orleans Utility.—The annual report of the New Orleans Public Service, Inc., for the year ended Sept. 30, 1923, recently made public, discloses an increase in electric revenue of $434,663 for 17,454,672 additional kilowatt-hours. There were increases in operating expenses for the gas and electrical units, however, which reduced the total earnings of the Public Service, Inc., by $128,041.

Record Installation of Electric Meters in New York State.—Two hundred and thirty thousand new electric meters were installed by the electric utility companies of the Empire State in the first nine months of the present year, according to a survey made by the New York State Committee on Public Utility Information. This marks a new record in extension of service and exceeds by 20 per cent the 190,000 meters installed during the first nine months of 1922.

Unique Street-Lighting Standards to Be Used in Kansas City.—In a new residence subdivision, called the Indian Village, recently opened in Kansas City, Mo., at Fifty-eighth Street and Wornau Road, the street-lighting standards will be in the form of totem poles. These unique posts were designed by Arthur Frederick Adams, a Kansas City architect and are a combination of totem pole and Aztec Indian obelisk. There will be sixty-eight of them, made of terra cotta, each one 18 ft. high.

Maquoketa, Iowa, Installs Municipal Lighting System.—The Iowa Electric Company's street-lighting service at Maquoketa has ended, the company's efforts to enjoin the city from operating its own plant having failed. The city lighting system consists of 120 lamps of 250 cp. Fifty more lamps in the outlying districts will be added in a few weeks. This does not include the boulevard lamps, which the city has lighted for two years. The Iowa Electric street system consisted of 138 lights of 80 cp.

Perfection of Electric Device for Stopping Motors from Distance Not Confirmed.—Reports that French and German electrical engineers have perfected a device by which motors on automobiles, and perhaps airplanes, can be stopped from a distance have been investigated by army radio and engineering experts and found to be exaggerated. The investigations were made at places where reports said the devices had been successfully demonstrated in France and Germany, but as yet nothing has been discovered by the army experts to indicate that the device has been found practicable.

Five-Thousand-Dollar Prize for Storage-Battery Locomotive.—The Department of Mines of Great Britain has offered a prize of £1,000 for the best design of a storage-battery locomotive suited for use in the deep mines of the British Isles. It is recognized that American competitors for this prize will have a distinct advantage owing to the higher state of development of storage-battery locomotive manufacture in this country. The contest will be open until April 1, 1924. Details may be had from the secretary of the Storage Battery Locomotive Competition, Department of Mines, London, S.W. 1.

Florida Soon to Have Utility Information Bureau.—On Nov. 21 about forty representatives of utility companies operating in Florida met at the Hillsboro Hotel, Tampa, to discuss the formation of a Utility Information Bureau for that state. A pre-organization committee appointed to prepare the plans consists of A. W. Houston, Southern Utilities Company, Palatka, Fla.; D. A. Cheney, Orlando Public Service Company; T. J. Hanlon, Jr., Tampa Electric Company; B. M. Latham, St. Petersburg Lighting Company, and H. H. Hyman, Miami Electric Light & Power Company.

Reduction of Missouri Power Rates.—The Empire District Electric Company, which supplies electrical energy to Joplin, Webb City, Carterville, Carthage and other places in southwestern Missouri, has been ordered by the Missouri Public Service Commission to put a reduced schedule of power rates into effect on Dec. 1 that will effect a saving of $120,000 a year to consumers. The new schedule eliminates a surcharge of 6.18 mills per horsepower-hour and the readiness-to-serve and consumption charges are reduced. Lighting rates are not affected, as the company did not increase those rates during the war period.

Drought in Wisconsin.—Drought has interfered with the production of hydro-electric power by the many water-power plants in Wisconsin. Two of the largest, situated on the Wisconsin River at Kilbourn and Prairie du Sac, which furnish 10 per cent of the total power requirements of the Milwaukee Electric Railway & Light Company and its subsidiaries, have both been unable to supply the maximum amount of electricity specified in contracts. At Portage the Wisconsin River is more than a foot below normal, while other streams are also very low, and central-station companies have had to depend on their steam or oil-burning plants and to call on interconnected companies to make up the deficiency.

Southern Power Company Rate Hearing. — The petition of the Southern Power Company for an increase in rates of approximately 10 per cent came up for hearing before the Corporation Commission of North Carolina last week. About thirty textile mills and other industries and two or three towns which buy power at wholesale are opposing the increase. The power company's contention is that the present rates do not afford a reasonable return on its investment and that under these circumstances it cannot get capital for expansion. The only witness heard by the commission was W. S. Lee, vice-president and general manager of the power company. The opponents of the increase did not desire to present evidence but asked that the commission make a thorough inquiry into the business of the company. Each side will have fifteen days after receipt of the transcript to file briefs.

Municipal and Central-Station Rivalry at Richmond, Ind. — The municipal board of works of Richmond, Ind., has declined to enter into a contract with the Terre Haute, Indianapolis & Eastern Traction Company which would permit the latter to build and operate a high-voltage electric line through the city of Richmond. The traction company had agreed that it would not sell electrical energy in Richmond or Wayne Township if permitted to maintain the feed line through the city, but the opinion prevailed that the company was becoming a direct competitor with the city in the power business in which both are engaged. The company may appeal to the Public Service Commission.

Area Charge Proposed in Indiana.—The Northern Indiana Gas & Electric Company, which in a conference with the Indiana Public Service Commission agreed to a reduction in electric rates in Lafayette estimated at about $30,000 or $35,000 a year, has proposed a new basis for its rates in that city. Instead of charging 10 cents a kilowatt-hour for the first 25 kw.-hr., ranging down to 7 cents a kilowatt-hour, with a monthly minimum of $1, the company proposes an area charge of 40 cents a month for the first 500 sq.ft. of floor area and 5 cents for each additional 100 sq.ft. plus an energy charge of 6 cents a kilowatt-hour, with $1 monthly minimum and with 1 cent a kilowatt-hour deduction for prompt payment. A new basis for commercial charges also is proposed. The company seeks to put the new schedule in effect Dec. 1.

Puget Sound Company to Spend a Million Dollars.—Expenditure of $1,000,000 in new hydro-electric power development by the Puget Sound Power & Light Company of Seattle in the immediate future is announced by A. W. Leonard, president, who recently returned from an extended Eastern trip. "Whether the contemplated development will take the form of enlarging one of our ten present hydro-electric plants or the installation of an entirely new project," said Mr. Leonard, "will be decided in the near future. It depends upon a comprehensive survey we are making of the power needs of the entire district. Whichever decision we reach will mean material additional use of Washington's water-power resources. The entire new unit which we may decide on represents an investment of $5,000,000 to $6,000,000."

Associations and Societies

New York Electrical Credit Association.—The twenty-eighth annual meeting and dinner of this association will be held on Wednesday, Dec. 12, at the Building Trades Club, 34 West Thirty-third Street, at 6 p.m.

American Physical Society.—At the one hundred and twenty-third regular meeting of the American Physical Society, held at the University of Chicago on Nov. 30 and to continue Dec. 1, Dr. Niels Bohr was scheduled for an address on "The Quantum Theory of Atoms with Several Electrons." Many other papers related to electrophysics were to be presented. The annual meeting of the society is to be held at the University of Cincinnati on Dec. 27-29.

Lighting Fixture Associations Dine.—At a joint dinner in New York on Nov. 21 of the Association of Lighting Fixture Manufacturers and the New York division of the National Council of Lighting Fixture Manufacturers, presided over by Herman Plaut, chairman of the national body, there were addresses by Edward L. Cox, Robert Biddle, Fred R. Farmer, Charles H. Hofrichter and Bernard Blitzer. Chairman Plaut cited the fact that within the past year thirty-four hotels, representing an investment of $34,000,000, and eighty-eight apartments, representing $120,000,000, have been erected in New York City, yet less than 1 per cent of this total investment was spent for lighting fixtures. Mr. Blitzer estimated the total sales of lighting fixtures for the past year at between $225,000,000 and $250,000,000.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See July 7 issue, page 56, for latest list.]

American Society of Mechanical Engineers—New York City, Dec. 3-6. C. W. Rice, 29 West 39th St., New York.

National Association of Railway and Utilities Commissioners—Hotel Urmey, Miami, Fla., Dec. 4-7. J. B. Walker, New York Transit Commission, New York City.

Accounting National Section, N. E. L. A.—Hotel Muehlenbach, Kansas City, Dec. 10-11.

American Physical Society—University of Cincinnati, Cincinnati, Dec. 27-29. H. W. Webb, Columbia University, New York City.

American Engineering Council (F. A. E. S.)—Washington, Jan. 10-11. L. W. Wallace, 26 Jackson Place, Washington.

Wisconsin State Association of Electrical Contractors and Dealers—Pfister Hotel, Milwaukee, Jan. 17-19. H. M. Northrup, 23 Erie Street, Milwaukee.

Western Association of Electrical Inspectors—Hotel Fontenelle, Omaha, Jan. 29-31. W. S. Boyd, 175 West Jackson Blvd., Chicago.

American Institute of Electrical Engineers—Midwinter convention, Philadelphia, Feb. 4-8. F. L. Hutchinson, 33 West 39th St., New York.

Commission Rulings

Depreciation of Overheads. — The theory of not depreciating any overheads, said the Michigan Utilities Commission in a case affecting the Detroit United Railway, is only defensible upon the hypothesis that the property is to be continuously maintained in operating condition from operating revenues and that no capital contributions are to be made thereto; but probably those overheads allocable to property whose maintenance is constantly chargeable as an operating expense, paid from operating revenues and not charged to capital account, ought not to be depreciated as a matter of accounting practice in public utility operation.

Importance to the Public of Sound Financing of Utilities.—Dwelling on the common interests of public utility companies and the customers they serve, the Illinois Commerce Commission, in a finding affecting the Chicago Telephone Company, went on to say: "The valuation of the company should be such that capital seeking investment will flow in sufficient amount into the securities of the company that it may make, without any considerable effort, necessary investments to insure public service. Again, its securities should be maintained at or near par in order that an undue burden should not be thrown upon the operating department of the utility in order to amortize any undue costs of selling securities or of securities sold at much less than par. In this regard the financial structure of a company is a matter of grave import in that the financial structure should be so devised that the securities of the company may have the widest possible market and its structure so simple that any person having funds to invest might find the securities of the ordinary utility available for such investment. Some courts have said that the value is to be fixed as of the date of the inquiry. This may be true as a strictly legal proposition, but in considering all of the economic laws governing the perpetuity of a company in service, a fair value must be so fixed as will, within reasonable conditions in the future, furnish a safe and reliable valuation both for the flotation of securities, for the security of capital invested and for furnishing a field for the investment of new finances in the future development of the company. In this regard not only must the commission be governed by considerations of a value and rate not subject to the criticisms of confiscation, but it must also consider trend of prices, original cost, reproduction cost and all other considerations which may in any manner assist the commission in fixing a value which, in the fluctuation of prices and cost reasonably to be expected in the immediate future, will carry the company through on a safe, sound and economic financial basis."

Outside Utility Company Cannot Intervene to Upset Sale of Municipal Plant.—In sustaining the sale of the municipal electric plant of Cambridge City to Robert S. Ashe and denying to the Interstate Public Service Company, another bidder, the right to intervene, the Indiana Public Service Commission said that a public utility company which has bid for a municipal plant offered for sale, but which is not a resident of the municipality or a taxpayer thereof and which has no vested right in the town or interest in the result of a proceeding for the confirmation of the sale, is not entitled to intervene on the ground that errors or irregularities entered into proceedings leading to the sale to another bidder of the property which the utility company sought.

Recent Court Decisions

New York Law on No-Par-Value Stock Issues by Utilities.—The Supreme Court of the State of New York has declared, in People vs. Liberty Light & Power Company, that under the stock corporation law and the Public Service Commission law of the state a light and power corporation may issue stock of no par value in exchange for all the outstanding stock of par value, without authority from the Public Service Commission, and still not incur a penalty under the Public Service Commission law. (210 N. Y. S. 302.)*

Owner of Dam May Not Capriciously Release Water to Injury of Ice Harvester.—Taft vs. Bridgeton Worsted Company was a suit for damages for injury to an ice crop because of the release of water stored for the operation of a mill plant. The Supreme Judicial Court of Massachusetts, upsetting in part a verdict for the plaintiffs, decreed that since the plaintiffs had only a license from the owner of the artificial pond to take ice, for which no consideration was given, they could not sue for damage to the ice, the damage to their revocable license not being recognized as injury to their property. The court, however, asserted that one who had by easement acquired the right to build a dam, thus overflowing another's land, could not through mere caprice draw off the water at a time when he knew that it would inevitably cause serious damage to the owner of the land by destruction of ice, if the right to take the ice could be exercised without legal injury to the owner of the dam. (141 N. E. 119.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Decisions Must Be Based on Facts Established, Not on Independent Knowledge Acquired. — The Supreme Court of Oklahoma has overruled a finding of the Oklahoma Corporation Commission against which the Oklahoma Natural Gas Company took action, on the ground that the rights of the parties depend upon facts established at the hearing, and not upon some independent knowledge of the commission acquired after the hearing. "There being no evidence to the effect that the price of gas at the mouth of the well had declined," said the court, "but the evidence all being to the effect that at the time of the hearing the company was compelled to pay 10 cents per 1,000 cu.ft. therefor, we must disregard this finding of the commission. A finding without evidence to support it is arbitrary and baseless."

Damages for Flowage.—In Fritz vs. Southern Wisconsin Power Company, a suit for damages to farmland resulting from flooding caused by the erection of a power dam, the Supreme Court of Wisconsin reversed a judgment for the plaintiff, holding erroneous an instruction permitting assessment of damages to land in the amount of the damage to the part subjected to flowage, with its added value as part of the whole, plus the damage to the rest. The court disagreed with the method of appraisal, especially in view of the fact that large damages were assessed. The owner, the court held, was entitled only to the amount by which the value of the entire property was lessened. Land used for a ferry landing, across a river from land subjected to flowage by the building of the dam, was held to be improperly considered as part of the owner's farm in determining his damages. (195 N. W. 321.)

Whether Height of a Dam Was Raised and Whether It Caused Flowage Are for Jury. —In Pajak vs. Chicopee Manufacturing Corporation and two other suits the petitioners alleged that the respondent maintained a dam across the Chicopee River for the purpose of operating a mill, and that by reason of the maintenance of flashboards and the heightening of the dam itself respondent had caused the water to run to a greater height than theretofore and to overflow petitioners' lands, to their loss and damage. The Supreme Judicial Court of Massachusetts has refused to overrule verdicts for the plaintiffs, holding that on all the evidence the jury could find that the flashboards had been raised and that the flowage of the land in 1918, 1919 and 1920 was caused, not by excessive rainfall, but by the backwater from the river, and that there was a causal connection between the raising of the flashboards and the flooding of the land. There was more than a mere scintilla of evidence in support of the petitioners' contention and, however probable the evidence of the respondent might appear, the decision of the jury could not be overruled. (141 N. E. 112.)

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

George Slater has succeeded E. E. Hanks as engineer of power station of the Minnesota Electric Light & Power Company, Bemidji, Minn.

J. S. Johnston, formerly division manager of the Brooke Electric Company, has been transferred to the security sales department of the West Penn system.

Dr. Robert A. Millikan of the California Institute of Technology, recently awarded the Nobel Prize for physics, has been awarded the Hughes medal by the Royal Society of London in recognition of his determination of the electronic charge and other physical constants.

L. W. Robert, industrial engineer of Atlanta, was presented with a gold watch and chain by the members of the Georgia Electrical Association at its semi-annual meeting at the East Lake Country Club in Atlanta on Nov. 7, as a token of appreciation for his services as the first president of the organization and his subsequent work in its behalf.

Guy S. Nunemaker, formerly general superintendent of the Tennessee Power Company at Chattanooga, Tenn., and recently general manager of the Cumberland Power Company, has been appointed general manager of the Southern Cities Utilities Company's holdings in Tennessee and Alabama, with offices at Chattanooga. This company operates in about thirty cities in Tennessee and Alabama.

L. A. Osborne, president of the Westinghouse International Company, has been decorated by the Japanese Emperor with the Third Order of the Rising Sun, according to a cable just received from Japan. Mr. Osborne received the Fourth Order on a previous visit. General Guy E. Tripp, chairman of the Westinghouse Board, was decorated with the Second Order of the Sacred Treasure (the highest Japanese civilian decoration) on his arrival in Japan, as reported in the ELECTRICAL WORLD of Nov. 2. General Tripp and Mr. Osborne are now on their way to Shanghai, and they will return to the United States by way of India and Europe.

David R. Cooper, formerly connected with the Fargo Engineering Company of Jackson, Mich., has recently opened offices in Syracuse, N. Y., as a consulting hydraulic engineer. While associated with the Fargo company Mr. Cooper had charge of design of the hydro-electric plant at Jim Falls, Wis., and he previously served as engineer in the hydraulic division of Stone & Webster, Inc. His earlier connections include the position of designing engineer with the New England Power Company, assistant chief engineer with the Salmon River Power Company, chief engineer at Minetto, N. Y., of hydro-electric development, engineer-secretary of the New York State Water Supply Commission, hydraulic designer of the Electric Bond & Share Company and assistant engineer-designer of the New York City Board of Water Supply.

Sir Philip Dawson, British Electric Railway Pioneer

Sir Philip Dawson, member of Parliament and partner in the firm of Kincaid, Waller, Manville & Dawson, consulting electrical engineers, London, has built or been connected with most of the big electric traction installations in Great

SIR PHILIP DAWSON

Britain, the Dominions and South America. He was a pioneer in British railway electrification, and during his association with the electrical industry he has been called in by many railway companies and public and private interests to advise on large traction and electric power schemes. For five years before the war he gave a post-graduate course of lectures on railway electrification at the Imperial College of Science and Technology, South Kensington, which he has continued since 1919. Sir Philip has served as a member of the Board of Trade water-power resources committee, to which he devoted much time. The Belgian government, too, availed itself of his services when it appointed him vice-president of the royal commission organized during the war to report on the advisability of electrifying the Belgian State Railways. Sir Philip has been the recipient of various medals awarded for papers of distinguished merit read before engineering societies, and he is also the author of the first standard works on electric railways.

H. T. Shaffer is now chief engineer of the Dunbar (Pa.) Electric Company, succeeding Clark White.

William Shannon, formerly connected with Stone & Webster's Seattle office, has been transferred to the San Francisco office of the company.

T. F. Malone has been made superintendent of water-power plants of the Adirondack Power & Light Corporation, Amsterdam, N. Y.

E. E. Helm, manager of the industrial bureau of the Akron Chamber of Commerce for the past two years, has been appointed district manager at Detroit of the Bridgeport Brass Company.

E. T. Anderson has assumed the duties of electrical engineer for the Water and Electric Light Commission, Lansing, Mich. Mr. Anderson was formerly electrical engineer with the firm of Smith, Hinchman & Grylls of Detroit and was in direct charge of the electrical work of the new municipal plant for that city.

H. L. Unland, for thirteen years engineer with the General Electric Company, eleven years of which were spent in the power and mining department, leaves that company on Dec. 1 to become electrical engineer with the Victor Talking Machine Company at Camden, N. J. After being graduated from the Engineering College of the University of Nebraska Mr. Unland entered the General Electric test. He was in charge of the water-rate test and later became connected with the power and mining engineering department on power and transmission station applications. He has specialized in electric welding and is the author of many articles on this subject.

Obituary

Edward Lloyd Cooley, in charge of small-motor contracts for the Boston office of the General Electric Company, died suddenly at his office on Nov. 22. He was born in 1859 and entered the company's service in 1900, later becoming district manager of the small-motor department with headquarters at the Lynn works.

Victor E. Raggio, for more than a quarter of a century prominent in electrical circles in the Southwest, died recently in Dallas, Tex., after a long illness. At the time of his death Mr. Raggio was commercial engineer in the power division of the Dallas Power & Light Company, a position he had held for several years after returning to business activities following a period spent in retirement on his ranch at Fort McKavett, Tex., where he went in search of health. Mr. Raggio was successively Texas representative of the Western Electric Supply Company and manager of the General Electric Company's branch in Dallas. He was widely known in the electrical trade of the Southwest and in business circles throughout Texas. Mr. Raggio was fifty-eight years of age.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Service Stations as Good-Will Builders

How an Adequate Service Department Helps the Sales Department, Speeds Repairs and Aids the Purchaser

BY "OBSERVER"

CLOSE contact between manufacturers of electrical appliances and their customers is one of the most vital factors in building and maintaining good will on the part of purchasers. Successful national manufacturing of electric ranges, irons, toasters, water heaters and other appliances, light or heavy, must be done on a mass-production basis under present conditions of industrial development. This means that weaknesses in design or construction are multiplied through duplication of products unless they are caught and taken care of almost immediately after the device gets into service. A sensitive contact with the retail market is the answer, and this can be obtained through the local service station with the co-operation of the jobber if both these institutions are "on their toes."

An adequate service station must perforce be organized and run upon modern business principles. A typical station meeting the needs of a group of Eastern states contains an attractive office for the regional sales manager, his assistants and clerical staff; a well-lighted and commodious display room and a carefully systematized stockroom, with repair facilities for the lighter troubles arising in the use of the products of this house. This establishment does not undertake jobbing, although it is necessary to wholesale a small amount of stock during holiday periods to meet eleventh-hour demands for equipment and units and also to accommodate members of the local "electrical family" in the territory. In this particular case sales of appliances are handled through this office and station to a few large electric utility holding corporations or operating syndicates, with a close contact between the manufacturing company's representative and the utility purchasing agents and sales managers that speeds up the service and greatly facilitates "ironing out" troubles which occasionally arise in the field.

Upon the prompt handling of repairs depends in no small degree the good will of the regional trade. Hence special care has been taken to classify all repair and replacement jobs according to the day each is to be finished, and compartments are provided, one for each weekday, to hold equipment due to be repaired within a stated short time limit. In this way it is usually possible to give a twenty-four-hour service, and the cut-down of lost time resulting from the use of electricity from central-station mains is much appreciated by the utilities. The repair staff is not permitted to leave the office on Saturdays until the bins for Friday and preceding days are cleared.

AN EXHIBIT OF "THE LINE"

This work involves the maintenance of about 25,000 parts for use on the premises or for sending out into the field on receipt of requests for such items, but with modern adjustable shelving and flexible compartments it is possible to handle this stock with a minimum of difficulty. The value of the heating elements carried as spares, however, is large enough in the mass to require a careful accounting of stock, and access to it by unauthorized persons is not favored.

A well-arranged exhibit of the major devices manufactured adds to the usefulness of the service station, and this includes a standard display case, which can be purchased for retail use if desired and which has provision for the "knock-down" exhibition of disassembled parts of typical equipment such as flatirons and toasters. These displays are well illuminated, easy of inspection by the visitor, and they save much time and eliminate many chances of error in ordering spare units or duplicate parts. The purchaser merely has to point to the part which he needs in order to obtain it—a decided contrast to the usual method of making a personally conducted or solitary trip through a catalog in order to find a particular item which may be designated as the manufacturers "Style No. 456,998, type B-3, unit," with all the possibilities of misquoting the catalog or picking out the wrong number and having to send back the part because it does not fit, with consequent loss of time and money by all concerned.

The mere concentration of devices in a sales office, of course, amounts to little without an alert personnel, interested in following up every service lead obtainable. Precautions against loss of material shipped in for replacement or repairs pay well. In the establishment in mind above a special compartment is reserved for devices mailed in to the station without explanatory letter or other adequate tagging. Since these are few in number, they are quickly identified when the user or his agent makes himself known; no time is lost in hunting these strays, and better service is rendered. The final success of a service station rests upon the men and women who work therein and upon the field personnel who utilize such a regional headquarters as a divisional staff office through which field experience clears to the manufacturing plant itself and where needs arising today can be met by tomorrow at the latest.

Importance of Timely Information on Credits

ROOM exists for much improvement in mercantile agency reports as regards timeliness, according to H. D. Clark, Van Brunt Porcelain Company, Columbus, Ohio, who spoke before a recent meeting of the National Electrical Credit Association. From many business concerns

today, according to his experience, the credit man is able to get only reports dating from six months to two years prior to the request. Many irregularities can occur during such a period, and such old reports are of no value as bases upon which to accord credit.

"Every concern transacting business on a credit basis," said Mr. Clark, "is, in buying, obligated to those who extend credit to it. The credit seeker should realize the necessity of being in position to furnish real up-to-date information based entirely on solid facts and the individual, firm or corporation which does not maintain records that will enable it to furnish proper information in regard to its condition, brought up to within thirty days of date of the demand for such information, is placing itself in a position that would justify its being looked upon as a doubtful credit customer. Such a condition gives reason to wonder, if the records do not receive proper attention, what kind of attention an account would receive. Therefore, just as we say that we can always tell a workman by the tools he uses, indicating that if the tools are not adequately adapted to his craft or are poorly kept he is not an efficient workman, the same inference can be drawn concerning any business house with incomplete or out-of-date records.

"Another important feature in the compiling of a mercantile report is the fact that few of them are verified by city, county or other legal records. Much information of real value is obtained by the use of such investigations. No mercantile report can be too complete, and those extending credit, irrespective of to whom, should not stand subject to criticism in their endeavor to obtain full details. There are many concerns today which, in addition to mercantile reports, employ attorneys to investigate such legal records as it is believed contain information of transactions by the applicant for credit or between him and others.

"In the desire for credit information one must be willing to give as well as to receive, and credit men are organized, not for the purpose of malice, but to help one another toward a betterment of conditions."

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

CENTRAL station purchases of line construction material for the purpose of pushing outside construction work to completion before the coming of the first winter storms was a feature of the market this week, both in New England and the northern states of the Middle West. Aside from this the main interest of both the wholesaler and the retailer has centered on the holiday market which is steadily increasing in its activity. Orders for the full line of Christmas gift appliances, portable lamps and many of the larger household devices are pouring in. Deliveries are prompt and in the main prices are firm.

New England jobbers are buying other lines in small quantities, but the general feeling is that business is good. Electrical manufacturers are busy. In the New York section general business fell off a bit, but this was not considered important inasmuch as the dealer is intent on holiday trade. Good crops in the Southeast have stimulated building which is beginning to react in the electrical market on the demand for wiring material. Steady buying of radio and appliance lines continues in Chicago and there is a lively expectation there that there will be an increase in the price of rigid iron conduit and wire. Construction material and high-tension equipment holds steady. On the Coast Christmas selling seems to be running well ahead of previous years. Telephone and power extensions are active and creating a steady demand for wiring material. The building movement continues unabated, showing that general business is in a very satisfactory condition.

Motors at Record Production; Market Awaits Applications

ACCORDING to statements made by several leading motor manufacturers within the past few days, the motor-manufacturing plants, taken as a whole, are as busy as at any time during their history, even at the 1920 peak. It is pointed out that this condition has not been generally apparent because of the custom of measuring production in terms of dollars' value of either production or sales rather than in terms of total horsepower rating or total number of units produced. The variation in the intrinsic value of the dollar, used as a measure of production, has thus hidden the fact that the continued electrification of manufacturing establishments goes ahead without abatement.

One prominent motor manufacturer says that a more or less definite level of total motor production in the United States has been reached owing to the fact that the available business in horsepower with present knowledge of motor applications is more or less definitely fixed and that the job is to manufacture motors for this more or less definitely known utilization market. He adds that only the opening up of new applications is awaited to see further demands made upon motor manufacturers to produce greater quanties. Another manufacturer says he sees as one reason of present activity a more intelligent development of the foreign market, which is waiting and ready to absorb large quantities of American-made motors as fast as American motor manufacturers can establish the correct sort of foreign representation or, preferably, place their own representatives in foreign fields.

Portable Lamp Factories Rushed with Orders

PORTABLE-LAMP manufacturers appear to be turning out their product in a sort of whirlwind finish of the year's work, the demand in representative sales offices exceeding that of last year by 50 per cent or more and mounting up to a record surpassing all previous experience. There is little opportunity to build up factory stocks under these conditions, and the feeling is very strong that the coming year will be a prosperous one in this branch of the industry.

Last week a representative of the ELECTRICAL WORLD visited a leading portable-lamp manufacturing center in Connecticut and was informed that while factory stocks of raw materials are rather low, no difficulty is being experienced in obtaining shipments of brass from adjacent mills in ample quantities to keep up with current demand. The supply of glass, recently short and disquieting, has now improved very decidedly. Enough business is now on the books of one leading manufacturer of portables to keep the plant running full time for the next six months.

Insulator Makers Increasing Capacity; Demand Continues

DELIVERIES of porcelain insulators, both pin and suspension type, have changed only slightly as compared with conditions as they existed early this summer, and promises of a definite shipping date are still often the main consideration in selling this equipment. Delivery dates for insulators manufactured in the Chicago territory run from two to six months.

In spite of this bugbear of slow deliveries, however, the demand does not seem to slacken materially. With so much line construction during the past summer in many different parts of the country, sales of porcelain insulators have increased over 1922 by 20 to 25 per cent. Many of the power companies are going into higher-voltage distribution systems, which require longer strings of

suspension insulators, and this also tends to increase the time of delivery. The problem now before porcelain manufacturers is how to educate their buyers to anticipate as closely as possible their immediate needs and place orders accordingly. Unless some scheme is so worked out they fail to see just how they will be able to make their delivery schedules meet the rapidly increasing demand.

Little difficulty is experienced in obtaining the raw materials since the foreign shipments containing the basic clay commodities are arriving on frequent schedule, rather, there is not not enough manufacturing capacity to meet the rapid increases in demand for this equipment. From a manufacturing standpoint labor has ceased to be such a problem as it was in early spring and summer. In other words, the labor market is becoming saturated so that employers are in a better position to pick and choose their men than they were formerly. Prices on insulators are expected to remain firm as long as the basic commodities, including raw materials and labor, are offset against the excellent demand now felt, according to authorities in the field.

Radio Sales Reported 100 per Cent Above 1922 Figures

THE American people have invested $115.000.000 in radio sets and equipment this year and will probably double this amount in 1924, just as 1923 has seen the doubling of last year's sales. This remarkable statement was made by David Sarnoff, vice-president and general manager of the Radio Corporation of America, during the recent meeting of the Electrical Supply Jobbers' Association at Buffalo. Mr. Sarnoff said that within two or three years the radio industry will probably bulk larger in point of sales than the entire phonograph industry, which is now selling $400,000,000 worth of products annually.

To cite one instance of the extent to which radio is growing, the volume of the vacuum tubes now being sold reaches in value 20 per cent of the entire sales of incandescent lamps and from 25 to 33 per cent of the total volume of all merchandise handled by the electrical jobbers of the country is radio equipment

Already there are two million radio sets in use, including both the home-made and factory-built equipment, and it is estimated that there is today an audience of seven million people "listening in" and enjoying the entertainment and information that is being broadcast through the air.

Mr. Sarnoff predicts a superpower broadcasting service which will comprise perhaps three superpower stations —perhaps one in the East, one in the North Central section and one in the Northwest, with sending apparatus powerful enough to operate loud speakers in any part of the United States. The problem of increasing the power of present station outputs from 500 watts to 100 kw. and 200 kw. will not be difficult to solve, according to Mr. Sarnoff, since already 20-kw. tubes are being built the size of quart milk bottles and ten such tubes, of course, could constitute a 200-kw. station.

Wiring Device Makers Busy— Heavy Duty Switches Strong

INQUIRY into the status of wiring-device production shows a large volume of business at the factories now being handled, with exceptionally good sales of heavy-duty switches for electric range and other heating service. It would probably be fair to class present production as normal on lines of sockets and switches for household service, the total orders being filled running in representative cases slightly above pre-war values. Leading manufacturers report that wholesale buying is still on a hand-to-mouth basis and that factory stocks tend to run higher than they should. Deliveries are easy, except that heavy-duty material is out of factory stock in some lines. Foreign sales are not very impressive except in the heavy-duty line, which is being exported to England in large quantities at present.

Within the factories wages appear to be at the peak and labor well employed. One large establishment is running overtime three evenings a week at present filling accumulated orders. The year's increased demand for electric cooking equipment has been reflected in this field. It is said on good authority that margins of profit are narrow in the common lines of wiring-device manufacture and that a much greater volume of business than formerly has to be handled in order to attain satisfactory figures. Raw materials are plentiful and easily obtainable.

Collections are giving little trouble and prices appear to be firm without much fluctuation for the time being. Modern methods of manufacture are improving internal conditions in some of the wiring-device plants, and the value of this year's output in a representative case will run as high as $5,000 per employee. If the expansion of the building industry continues during the coming year, the outlook will be favorable for the wiring-device branch of the industry.

October Electrical Exports Gained $912,120

TOTAL exports of electrical machinery, apparatus and appurtenances for October were $6,035,410, an increase of $912,120 over October, 1922, when the total amounted to $5,123,290. In September, 1923, total electrical exports amounted to $5,925,529. The accompanying figures are supplied by the Bureau of Foreign and Domestic Commerce.

ELECTRICAL EXPORTS FOR OCTOBER, 1923, COMPARED WITH CORRESPONDING MONTH A YEAR AGO

	Value October 1922	Value October 1923
Turbines	26,770	31,172
Generators:		
Direct-current:		
Under 500 kw.	33,600	71,078
500 kw. and over	132,272	41,406
Alternating-current:		
Under 2,000 kva.	19,780	5,295
2,000 kva. and over	165,390	111,980
Accessories and parts for generators	44,661	166,755
Self-contained lighting outfits	32,265	56,719
Batteries:		
Primary	82,586	99,654
Storage	165,044	196,342
Power transformers	84,191	199,987
Other transformers	33,552	63,003
Rectifiers, condensers, double-current and motor generators, dynamotors, synchronous and other converters	55,377	57,801
Switchboard panels, except telephone	252,621	78,185
Switches and circuit breakers over 10 amp.	119,424	185,345
Fuses and fuse blocks	19,652	38,129
Watt-hour and other measuring instruments	53,003	39,579
Volt, watt, and ampere meters and other recording, indicating and testing apparatus	66,691	96,700
Lightning arresters, choke coils, reactors and other protective devices	35,535	47,233
Motors under 1 hp.	83,791	117,505
Stationary motors, 1 to 200 hp	156,018	334,899
Stationary motors, over 200 hp	24,794	86,740
Railway motors	112,158	11,500
Electric locomotives:		
Railway	10,000	
Mining and industrial	19,779	18,126
Other motors	6,685	12,750
Rheostats, controllers and other starting and controlling equipment	62,246	131,963
Accessories and parts for motors	63,874	173,001
Electric appliances:		
Electric fans	45,575	62,201
Electric lamps:		
Incandescent carbon-filament	2,893	3,968
Incandescent, metal filament	138,022	118,053
Other electric lamps	23,980	19,723
Flashlights	31,896	36,479
Searchlights and projectors	89,196	19,839
Motor-driven household devices	83,928	41,707
Domestic heating and cooking appliances	76,789	88,915
Industrial electric furnaces and ovens	46,279	12,019
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc	64,862	56,257
Radio and wireless apparatus	564,803	270,061
Telegraph apparatus	38,887	19,205
Magneto telephones	(2)	45,855
Other telephones	433,016	23,739
Magneto switchboards	(2)	25,402
Other telephone switchboards	(2)	37,154
Railway signals, switches and attachments	28,733	84,898
Bells, buzzers, annunciators, and alarms	6,760	8,011
Spark plugs, magnetos, and other ignition apparatus	88,373	124,975
Insulating material	80,542	123,978
Metal conduit, outlet and switch boxes	14,662	42,190
Sockets, receptacles and lighting switches	75,449	93,424
Other wiring supplies and fixtures	143,968	160,648
Other electrical apparatus not elsewhere specified	436,276	894,031
Globes and shades for lighting fixtures	40,089	51,775
Electrical lassware except for lighting	15,976	13,238
Electrical porcelain	72,606	215,842
Electrical carbons, carbon brushes, electrodes	93,330	226,697
Insulated wire and cable (iron and steel)	31,327	50,324
Other manufacturers of aluminum	93,874	110,563
Copper:		
Bare wire	128,613	267,178
Insulated wire and cables	170,827	274,214
Total	$5,123,290	$6,035,410

Porcelain, Wire and Conduit Mark Time in New York

PRICE uncertainties in the markets for porcelain, wire, conduit and some wiring devices are said to have caused a falling off in buying by the jobbers during last week in the New York territory. This hesitancy in purchasing from the manufacturer is not considered especially serious at this time because of the small volumes being consumed by the contractor-dealers, who now are devoting most of their efforts to a splendid appliance market.

During the week only fair orders were placed by the industrial and central-station companies of this territory. Material required to make installations and repairs before heavy winter weather arrives is in principal demand, and no further requirements are expected to be in evidence until after the first of the year. A feature of the market is the spurt in sales of new and second-hand motors for the garment trades.

Retail Trade on Coast Making Record; Construction Booming

GENERAL business conditions in the Far West are satisfactory with an encouraging volume of retail and wholesale trade. The electrical retail business is averaging better than the 11 per cent over last year which the department stores on the Coast are showing. This is largely because of increased radio business, but also due to hollow-ware sales, which have been growing, and to improved merchandising of the larger household appliances. Last year saw the general abandonment of "blind" door-to-door selling, and 1923 seems to mark the practical passing of the doorway canvassers. This has naturally had a good influence on store trade. Pre-holiday buying is holding up well, and the month of December is expected to show a very heavy volume of Christmas buying. The holiday shopping started somewhat earlier this year than usual, the retailers report.

The building boom which began over a year ago has continued so consistently that it has become a normal condition with no sign of let-up. All this has made a fine market for the electrical industry. A large number of new apartment houses have been equipped with electric ranges, which has developed a heavy increase in range sales.

There have been continued slight drops in some lines, especially conduit, wire and certain schedule materials, but it is believed the market will shortly stiffen. Competition in steel products is especially keen. Single switch boxes have just dropped to about $8.50 per 100 in lots of 100, and mill carload shipments of rigid iron conduit have decreased approximately 5 per cent in price. Copper, on the contrary, is steadily advancing, having risen about 1¼ cents per pound over the low mark of a month ago. Local stocks of all lines are good and, while rather high, are healthier than a year ago.

Telephone and power extensions in the Puget Sound district and the interior valley oil country report many extensions which have developed demand for wire, fixtures and other equipment. Reports show that agricultural crops were not only bumper in size, but, because abnormally late, were marketed with practically no loss. Collections are satisfactory.

Firm Prices and Diversified Demand Prevail in New England

ELECTRICAL trade conditions in the New England territory manifest increasing strength, with prompt deliveries and firm prices, barring a weakness of about 5 per cent in pole-line hardware, and a diversified demand. Outside construction by central-station companies is being pushed hard to complete as much work as possible before heavy winter weather sets in. Weatherproof wire is in active demand and prices are stiffening as the cost of cotton trends upward. A slight reaction in the price of copper had little effect on last week's wire market. Central-station expansion continues in both private and municipal utilities.

Jobbers are buying on a hand-to-mouth basis, but the volume of trade is so large that turnovers are quite satisfactory and manufacturers in many lines are unable to build up much in the way of stocks. Apparatus factories in New England are very busy, and so are lamp manufacturers. Normal outputs of wiring devices are reported from Connecticut. House wiring is a bit quieter, but appliance sales are growing by leaps and bounds. Kitchen-lighting units are moving fast in Massachusetts and lower Connecticut, and at Hartford a campaign for the sale of store-lighting units has made a flying start. Motor sales are fairly active in smaller sizes. In the textile field conditions continue spotty with marked curtailment and some pressure to bring about lower labor costs is apparent.

Southeastern Market Strong; Jobbers' Business Satisfactory

EXCELLENT weather conditions throughout the Southeast are tending to hold up general business activities, and electrical jobbers in Atlanta report their business during the past week as entirely satisfactory. The continued drought in the Carolinas and Georgia, while not so serious as it was thirty days ago, is still proving very expensive and embarrassing to the larger power companies, although no general shutdown is anticipated, owing to the ability to obtain steam power over interconnecting lines. The steel industry in the Birmingham section continues to hold up fairly well, with a possible improvement in the past thirty days, although some of the smaller mills are still shut down.

Alabama jobbers and central-station companies report electrical merchandising as on a splendid basis throughout the entire state, the smaller towns of from 500 to 5,000 population being exceptionally good. The outlook for a record holiday business in this state is very bright.

In Florida the citrus crop promises to be one of the best on record, and the tourist traffic, which is of great importance to that state, is already heavier than that of prior years. These facts have resulted in a spirit of optimism, which is reflected by a heavy building program of both residential and commercial types. The development of new residential subdivisions is causing a heavy demand for "whiteway" lighting fixtures, glassware, parkway cable and wire, one of the heaviest of these orders on record having been recently placed by real-estate firms in Miami. The building program is, of course, taking large quantities of electrical construction material.

Radio and Christmas Buying Are Features of Chicago Market

BUSINESS in the Chicago electrical trade seems about the same as last week. There has been an unusual demand for radio products, which might have been brought about by the radio show held recently at the Coliseum. Christmas buying is in full sway and appliance sales are best, with toasters, percolators and floor lamps selling in excellent volume.

Wire, which has been expected to advance at any moment, remains steady, although large orders have been booked for deliveries in the first quarter of 1924. Conduit sales have fallen off somewhat, and prices are firm. Several months ago, when the eight-hour day was put into effect at the steel mills, producers of conduit expected to be forced to advance their prices. Orders were accepted only for delivery at the price prevailing at date of shipment. This situation changed a while back, and the electrical trade was not

Comparative Prices of Station Supplies

	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars, per lb.	$0.0354	$0.0354	$0.0304
Cold finished shafting, per lb.	0.0465	0.0465	0.039
Brass rods, per lb.	0.1475	0.1525	0.17
Solder (half and half), per lb.	0.31	0.295	0 275
Cotton waste, per lb.	.10 to .13	.10 to .13	.09 to .11½
Washers, cast iron (⅜-in.), per 100 lb.	6.50	6.50	6.00
Emery, disks, cloth, No. 1, 6-in. diameter, per 100	3.38	3.38	3.02
Machine oil, per gal.	0.297	0.297	0.33
Belting, leather, medium, off list	30-10%	30-10%	30-10%
Machine bolts, up to 1-in. x 30-in., off list	40-10%	40-10%	40%

asked to assume the extra cost of production. It now seems that the expected added cost is to be passed on to the ultimate consumer. Just when is a matter of guesswork, but, with the increased demand for conduit at this moment, it would seem that the producers would judge this an opportune time.

With the cotton market at its high mark, tape manufacturers using cotton and varnishes maintain that there will be higher prices for these commodities at the first of the year. A concerted effort is being made by cotton growers to stabilize and uphold the price of cotton through banding together into an association, and it seems as if they may be succeeding. Construction material and high-tension equipment sales have been steady for this period of the year.

The Metal Market

A DECIDED lull in demand for copper appeared during the week. This was not unexpected in view of the large sales made during the first half of the month, and some authorities now estimate that the actual transactions thus far in the current month have involved as much as 250,000,000 lb. If these estimates are correct, a new high record for recent years on sales has been made. Many of the leading selling agents have disposed of all the copper they cared to for the current month, a fact which has been shown by their attitude in the market during the past week.

NEW YORK METAL MARKET PRICES

	Nov. 21, 1923 Cents per Pound	Nov. 27, 1923 Cents per Pound
Copper, electrolytic	13.00	12.62½
Lead, Am. S. & R. price	6.85	6.85
Antimony	9.50	9.25
Nickel, ingot	27.00 to 32.00	27.00 to 32.00
Zinc, spot	6.40 to 6.45	6.25
Tin, Straits	43.00	43.00
Aluminum, 98 to 99 per cent	26.00 to 27.00	26.00 to 27.00

The official contract price of lead as established by the American Smelting & Refining Company continues at 6.85 cents per pound, New York City. At this level it is possible to obtain lead for late December and January shipment. Prompt lead is scarce and can be obtained only by paying a premium. As high as 7 cents, New York, has been paid for spot lead in large quantities.

The slab zinc market has sagged, and prices have declined to 6.25 cents per pound, East St. Louis, for both prompt and forward metal. Sales have been fair, and the market seems to have been influenced by the drop in copper prices and the easier position of the stock market. Producers think that production is too high, especially in view of the improbability of any immediate export business.

Activities of the Trade

Devoted to News of the Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Wagner Electric Cuts Transformer Prices 8 per Cent

On Nov. 15 the Wagner Electric Corporation announced a reduction of 8 per cent in transformer prices. This price reduction applies to self-cooled transformers for both 25 cycles and 60 cycles, in sizes up to and including 500 kva., having a primary voltage rating of 46,000 or less. This reduction was made at this time as an incentive to customers contemplating the purchase of transformers in the near future to order now.

Department Stores Exhibit Their Electric Trucks by Parading

During the past month two New York City department stores, Gimbel Brothers, Manhattan, and Abraham & Straus, Inc., Brooklyn, have conducted electric truck parades in their respective communities to impress the public with the size of the trucking fleets necessary to deliver purchases. In each case the increasing number of electric trucks which are being employed for frequent-stop delivery work was made manifest.

Each electric truck in the service of Abraham & Straus is operated on a daily route of at least 35 miles when the batteries are charged every other day. This route mileage is much greater, of course, when batteries are charged daily. A total mileage of 69 on a single charge has been obtained in one instance.

"Amrad" Corporation Obtains Illinois License

The American Radio & Research Corporation, manufacturer of radio supplies and also of fractional-horsepower motors at Medford Hillside, Mass., has taken out papers authorizing it to transact business in Illinois. The capital stock is $500,000, of which $56,962 is to be employed in Illinois. William R. Watson, 203 South Dearborn Street, Chicago, is Illinois representative.

Edison Appliance Company Enlarges New England Office

The Edison Electric Appliance Company, Inc., with headquarters in Chicago, has increased its New England headquarters and service station space by about 33 per cent, including improved facilities for the display of light and heavy appliances, a re-arrangement of the stockroom layout, and better accommodations for the clerical and sales staff. These offices are at 99 Bedford Street, Boston, C. P. Myrick being New England manager.

Mr. Myrick is taking an active part in the co-operative campaign of the baking industry and manufacturing and central-station interests to promote the use of electric toast and the sale of toasters in this connection through electrical retailers. Mr. Myrick states that the current year bids fair to create a record in the sale of heavy-duty ranges and bakery equipment.

Chain Belt Establishes Direct Branches on Pacific Coast

The Chain Belt Company, Milwaukee, manufacturer of "Rex" chain, transmission machinery and conveying equipment, formerly represented on the Pacific Coast by the Meese & Gottfried Company, San Francisco, has established direct factory branches and warehouses in Portland and Seattle. Arrangements have also been made with the Washington Machinery Depot, Tacoma, Wash., to carry stocks. Other quantities of the firm's products will be placed in important centers throughout the Pacific Northwest for the prompt handling of local requirements.

The Northwest territory, headquarters in Portland, will be in charge of Allen C. Sullivan, formerly connected with the Allis-Chalmers Manufacturing Company, Milwaukee. Don B. Catton, formerly with Meese & Gottfried and later engaged in the machinery supply business on his own account, will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by William F. Nichols out of the Seattle office. Mr. Nichols for the past eleven years has also been connected with the Meese & Gottfried Company. The Portland office of the Chain Belt Company is at 67 First Street, Portland, and the Seattle office at 1040 Sixth Avenue, Seattle. Large stocks are maintained at both places.

Trojan Washer Distributor Organized to Serve Chicago District

The Trojan Washing Machine Company has been organized to serve as distributor for the Trojan washing machine in the Chicago district. Offices are at 7730 Cottage Grove Avenue, and the officers are: John S. Haines, president; Charles W. Watterson, vice-president; William Campbell, secretary.

This location also serves as the headquarters for other branch stores at Gary and Hammond, Ind., and Glenellyn, Ill. Mr. Haines was formerly with the American Finance Company, Indianapolis, and with the Standard Washing Machine Company, the predecessor of the Standard Domestic Appliance Company of Chicago, with which Mr. Watterson was formerly connected. Mr. Campbell is also sales manager of the Hogan, Spencer &

Whitley Company of Erie, Pa., which manufactures the Trojan washing machine.

Nulite Exploit Patent for Repairing Lamps

The Nulite System, Inc., 823 Land Title Building, Philadelphia, has been incorporated under the Delaware laws, with capital stock of $2,500,000, to exploit the Wilkins patent for repairing incandescent lamps. Present plans provide for opening a plant in Philadelphia, commencing Feb. 1, which will have a capacity for repairing 20,000 bulbs per day.

Radio Corporations Extensions in China Will Cost $13,000,000

The Radio Corporation of America, Woolworth Building, New York City, through its affiliated organization, the Federal Telegraph Company of California, San Francisco, is perfecting plans for a group of radio stations in China to cost $13,000,000 and to be completed in twenty-four months. The central plant in Shanghai will be of 1,000,000-watt capacity, with seven steel towers, each 1,000 ft. high, and power plant. Other stations will be at Pekin, Canton and Habin. R. P. Schwerin, president of the Federal company, will be in charge.

Philadelphia Division of Sturtevant Moves to Larger Quarters

On Nov. 19 the Philadelphia division of the B. F. Sturtevant Company, whose headquarters are in Boston, moved to a modern daylight building with a Pennsylvania railroad siding at Thorne and Copewood Streets, Camden, N. J. In this new location the company will maintain a modern shop for manufacturing all kinds of sheet-metal work required for the complete installation of fan systems, including heating, ventilating, drying, exhaust and conveying work. Guards for machines, pulleys and gears will also be produced and a large stock of standard equipment, such as pressure blowers, turbo undergrate blowers, blast gates, etc., will be carried. Capacity will be increased fourfold at this division.

Rawson Collier Opens Atlanta Office for Dwight P. Robinson

Dwight P. Robinson & Company, Inc., New York City, have opened an Atlanta office in the Healey Building, with W. Rawson Collier in charge. Mr. Collier was for many years with the Georgia Railway & Power Company and joined the Dwight P. Robinson forces several months ago, going to them from the Poughkeepsie Gas & Electric Company. He is a graduate of the Massachusetts Institute of Technology and has been prominently identified with the work of the National Electric Light Association, the American Institute of Electrical Engineers, the American Gas Association and the Illuminating Engineering Society.

The opening of the Atlanta office gives the company a total of eight branches. Other branches are at Chicago, Pittsburgh, Youngstown, Philadelphia, Montreal, Los Angeles and Rio de Janeiro.

Among the company's recent activities in the South are the new wet-process cement plant of the Lehigh Portland Cement Company at Birmingham, Ala.; extensions to the steel plant of the American Rolling Mill Company at Ashland, Ky.; extensions to the power generation and distribution systems of the New Orleans Public Service Inc., and the design and construction of the fifth sulphur mining plant which the firm has built for the Freeport Sulphur Company at Hoskins Mound, Tex.

Combination of Westinghouse and Japanese Interests Announced

Reports of an arrangement consummated between Westinghouse and Japanese electrical interests has been confirmed by cables received by the Westinghouse Electric International Company at New York City from General Guy E. Tripp, chairman of the Westinghouse board, and L. A. Osborne, president of the Westinghouse International Company, who are now in the Orient.

"The new company is known as the Mitsubishi Denki Kabushiki Kaisha, or, in English, the Mitsubishi Electric Manufacturing Company," states E. D. Kilburn, vice-president and general manager of the Westinghouse International Company. "I assume that the reported capitalization, 15,000,000 yen or $7,500,000, is correct, although word on this point has not been received.

"The Westinghouse company has for many years been engaged in promoting the use of electricity in Japan, and its efforts have met with so favorable a reception that Japanese electrical development compares favorably with that in the United States. This includes railroad electrification, the use of water power, the installation of large steam generating plants and the formation of superpower systems.

"As a consequence of this rapid development, electrical apparatus has become one of Japan's largest imports, and since Japan's principal exports, silk, copper and objects of art, cannot be expanded to a corresponding degree, the Japanese began to feel that there was danger of a continuing unfavorable balance of trade. Hence it seemed wise to Japanese interests to begin the manufacture of electrical machinery and supplies in their own country. In pursuance of this policy, the important Mitsubishi interests, which are engaged in banking, shipbuilding and steel making, approached the Westinghouse company with a proposal for a co-operative agreement whereby the company was to supply technical skill and experience to a Japanese manufacturing company.

"The Mitsubishi Electric Manufacturing Company is the outcome of these negotiations. The Japanese profit by the arrangement through the employment it will give to Japanese workmen and the improvement in their foreign trade situation while the Westinghouse company profits by receiving a continuous revenue for services and royalties in lieu of exports that it was certain to lose within a comparatively few years. The United States profits because if the Westinghouse company had not accepted this proposal, it is possible that a German firm would have been considered by the Mitsubishi organization.

"A third party to this agreement is Takata & Company, the well-known Japanese importers, with offices at 30 Church Street, New York City. This concern, which is the Japanese agent of the Westinghouse company, will play a large part as distributor for the Mitsubishi Electric Manufacturing Company and will also continue to import such Westinghouse products as will be supplied from America."

The Scovill Manufacturing Company, Waterbury, Conn., is reported to be planning to transfer its vacuum cleaner manufacturing department to the plant of the Hamilton-Beach Manufacturing Company, Racine, Wis., which was recently sold to the Scovill interests. The transfer, it is stated, will not involve enlargement of the Racine works.

The Maytag Company, North Fourth Avenue, Newton, Iowa, manufacturer of electric washing machines, agricultural implements, etc., is considering preliminary plans for an addition to cost $200,000. The larger part of the structure will be equipped as a foundry for aluminum casting production.

The Noyes Electrical Supply Corporation, recently organized in New York City with a capital stock of $50,000, announces that it will soon start the manufacture of a general line of household appliances.

Maydwell & Hartzell, Inc., San Francisco, representing electrical manufacturers on the West Coast, on Nov. 10 consolidated offices and warehouse in their new building at 158 Eleventh Street.

The Westinghouse Electric & Manufacturing Company last week received a contract from the Public Service Electric Company of New Jersey for station equipment to the value of $400,000.

The Handon Boiler Corporation, New York City, has been organized to act as manufacturers' agent in the distribution of boilers, tanks, etc. The present address is in care of J. A. McNamara, 165 Broadway, New York City.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired in Prague, Czechoslovakia (No. 8,236), for electrical equipment and novelties for automobiles.

Purchase is desired in Singapore, Straits Settlements (No. 8,235), for automobile accessories, including electrical equipment, lamps, etc.

An agency is desired in Bradford, England (No. 8,313), for electricl accessories for automobiles, flashlights and parts, lighting accessories and domestic electrical appliances.

An agency is desired in Birmingham, England (No. 8,272), for electrical engineering supplies.

Purchase is desired in Prince Rupert, Canada (No. 8,215), for large figures, toys and machines for electrical window display.

Purchase and agency is desired in Aleppo, Syria (No. 8,241), for ice-manufacturing machines.

Purchase is desired in Rio de Janeiro, Brazil (No. 8,246), for refrigerating machinery.

Purchase and agency is desired in Milan, Italy (No. 8,239), for electrolytic copper in bars and cakes.

Purchase is desired in Glasgow, Scotland (No. 8,270), for wire heating element.

TENDERS FOR EQUIPMENT FOR ELECTRIC PLANT AT DELHI, INDIA.—Tenders will be received by the Public Works Department, Delhi, India, until Jan. 21, 1924, for equipment for electric plant, including turbo-alternator set, condensing plant, cranes, economizer, switchboards, converters, boiler-house equipment, steel chimney, pipework, substation equipment, feeder cables and accessories. Specifications may be obtained from the chief controller of stores, engineering section, Indian Stores Department, Delhi.

TENDERS FOR COAL UNLOADING AND CONVEYING PLANT FOR SYDNEY, AUSTRALIA.—Tenders will be received by the City Council, Sydney, Australia, until Jan. 7 for a coal unloading and conveying plant.

New Apparatus and Publications

BATTERY CARRIER.—A battery carrier, "Acco," designed for use by service stations, radio "fans" and car owners, has been placed on the market by the American Chain Company, Bridgeport, Conn.

COMMERCIAL LIGHTING UNIT.—The Moran & Hastings Manufacturing Company, 16 West Washington Street, Chicago, has developed a new commercial lighting unit, known as the "Othello."

ELECTRIC RANGE UNITS.—The Edwin L. Wiegand Company, 422 First Avenue, Pittsburgh, has brought out a line of "Chromalox" range units for converting coal, gas and other types of ranges into electric ranges.

CABLE CONNECTOR.—The Pollack Conduit Company, 467 Greenwich Street, New York City, has developed a cable connector, "All-In-One," to fit any No. 14-2 armored cable.

VAPOR-PROOF LANTERN.—The Crouse-Hinds Company, Syracuse, N. Y., has brought out a portable vapor-proof lantern, known as type "VSB," for use wherever combustible vapor, gas or dust is present.

TRANSFORMERS.—Bulletin No. 2,028, entitled "Quantity Production Pittsburgh Distributing Transformers," issued by the Pittsburgh Transformer Company, Pittsburgh, describes the method of construction of the "Pittsburgh" transformers.

ELECTRICAL MEASURING INSTRUMENTS.—The Brown Instrument Company, Philadelphia, is distributing bulletin No. 105, covering its salinity meters, equipment for the measurement of electrolytic conductivity, surface condenser leakage and evaporator priming. Bulletin No. 100 covers its electrical instruments for ion concentration measurements.

CAR DUMPER.—The Wellman-Seaver-Morgan Company, Cleveland, is distributing bulletin No. 78, which describes and illustrates its "W-S-M" revolving car dumper.

CONDULETS, COVERS AND WIRING DEVICES.—The Crouse-Hinds Company, Syracuse, N. Y., is distributing a folder covering its flanged obrotund condulets, covers, and wiring devices.

FLEXIBLE COUPLING.—The De Laval Steam Turbine Company, Trenton, N. J., has issued a pamphlet describing the "De Laval" flexible coupling for turbines or motors geared or directly coupled to pumps, generators, etc.

INSULATORS, CLAMPS, ETC.—"Suspension Insulators, Clamps and Attachments" is the title of Bulletin No. 2, Catalog No. 25, issued by the Locke Insulator Corporation, Victor, N. Y., covering the "Locke" suspension insulators, attachments, etc.

New Incorporations

THE PRESTON COUNTY LIGHT & POWER COMPANY, Morgantown, W. Va., has been incorporated with a capital stock of $50,000 by H. C. Greer, A. W. Hawley, D. W. Saffel and others, of Morgantown.

THE CORTEZ (COL.) LIGHT, POWER & MILLING COMPANY has been incorporated with a capital stock of $50,000 by J. J. Downey, R. J. Bryce, J. W. Bozeman and A. W. Cowling.

THE LAURENS ROAD LIGHT & POWER COMPANY, Greenville, S. C., has been incorporated by W. P. Conyers, president, and James M. Richardson, secretary.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

FALL RIVER, MASS.—The Lawrence Plywood Company, recently formed, plans to construct a power house at its proposed new woodworking plant on site to be selected in Maine, to cost about $175,000.

WORCESTER, MASS.—The Boston & Maine Railroad Company plans to erect a power house on Millbrook Street, to cost about $65,000.

ROCKY HILL, CONN.—The Belamose Silk Corporation, 983 Main Street, Hartford, plans to erect a power house at its proposed local mill, to cost about $400,000. McClintock & Craig, 33 Lyman Street, Springfield, Mass., are engineers.

Middle Atlantic States

FREDONIA, N. Y.—The installation of electrically driven pumps in connection with proposed extensions to the waterworks, to cost about $200,000, is under consideration.

OAKFIELD, N. Y.—Electric power equipment will be installed in the new plant addition to be erected by the United States Gypsum Company, to cost about $85,000.

PALMYRA, N. Y.—Bids will be received by R. K. Fuller, Commissioner of Canals and Waterways, Capitol, Albany, until Dec. 18 for construction of power station and incidental work at Lock No. 29, Palmyra.

SALEM, N. Y.—The Salem Light, Heat & Power Company is considering plans for the construction of a new hydro-electric power plant, to cost about $100,000.

SYRACUSE, N. Y.—The City Council has authorized the extension of the ornamental lighting system through West Onondaga and Gifford Streets.

CLIFTON, N. J.—Bids will be received by the Passaic Valley Sewerage Commissioners, 24 Branford Place, Newark, until Dec. 4 for three electrically-operated centrifugal pumps, each with capacity of 6,500,000 gal.; one gasoline-driven electric generating set, switchboard, automatic control and auxiliary apparatus, for the Yantacaw pumping station.

HOLLAND, N. J.—The New Jersey Power Corporation has construction under way on a local electric plant on the Delaware River. A transmission line will be built from Gettysburg, Pa., to Dover, N. J.

ORANGE, N. J.—The Public Service Electric Company has purchased property at Oakwood Avenue and Prince Street as a site for a substation.

ERIE, PA.—The installation of a high-tension conduit system on Twelfth Street, to cost about $25,000, is under consideration. F. G. Lynch is city engineer.

GROVE CITY, PA.—Plans have been approved for new municipal power station near the city waterworks, the removal of the present plant on Main Street to this location and the installation of additional machinery. Contracts have been let for engines and generators. Awards for auxiliary machinery will soon be made.

McCALL'S FERRY, PA.—The Pennsylvania Water & Power Company plans to construct an additional unit at its local hydro-electric plant, to increase the capacity about 40,000 kw. A transmission line will be erected to York, 23 miles, and to Coatesville, 30 miles.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company contemplates the construction of a new carbarn and shops.

READING, PA.—The Thomas Jackson & Son Company plans to rebuild its power house and cordage mill, recently destroyed by fire, with loss of about $500,000.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company is considering a site on the waterfront for a new generating plant unit, to cost about $3,000,000.

OAKLAND, MD.—Plans have been prepared by Charles B. Hawley, consulting engineer of the Youghiogheny River Power Company and the Youghiogheny Water & Electric Company, for a hydro-electric development on the Youghiogheny River. The first development will be located where Deep Creek flows into the Youghiogheny, between Oakland and Friendsville. The plans call for a development of 100,000 hp., to cost about $35,000,000. The power will be distributed throughout western Pennsylvania.

CHARLESTON, W. VA.—The West Virginia Water & Electric Company is planning extensions to its transmission system in different parts of the county.

CHARLESTON, W. VA.—Bids will be received by the State Board of Control, Charleston, until Dec. 28 for construction complete of the Governor's mansion, including electric wiring, conduit system, intercommunicating telephone system, vacuum cleaner, heating system, etc. Walter F Martens is architect.

HUNTINGTON, W. VA.—Bids will be received by the United States Engineer Office until Dec. 19 for one Diesel engine and electric generator.

LOGAN, W. VA.—Steps have been taken by the Logan Chamber of Commerce for the installation of ornamental lamps on Stratton and Main Streets.

MORGANTOWN, W. VA.—The Preston County Light & Power Company, recently organized, contemplates building a power plant, to cost about $100,000. H. C. Greer is director.

TWIN BRANCH, W. VA.—The Fordson Coal Company, a subsidiary of the Ford Motor Company, Highland Park, Mich., plans to install electric power equipment and other machinery on its local coal properties.

NORFOLK, VA.—Plans are under consideration by the Ice Delivery Company for the construction of five ice and refrigerating plants in different sections of the city, with storage and distributing facilities, to cost about $250,000.

WASHINGTON, D. C.—Bids will be received by the chief signal officer, United States Army, until Dec. 3 for thirty-five transformers, 158 resistances and four coils. (Circular C.P. 15891-9.)

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until Dec. 18 for five electric grinders for the South Brooklyn Navy Yard and ten electric grinders for the Mare Island Navy Yard; also, for three electric drills for the South Brooklyn yard and eight electric drills for the Hampton Roads (Va.) yard. (Schedule 1608.)

North Central States

CADILLAC, MICH.—Bids are being received by the Consumers' Power Company, Jackson, for construction of dam and power house on the Manistee River, near Cadillac. E. M. Burd is engineer.

DETROIT, MICH.—The Cadillac Motor Company, Clark Avenue, plans to install electric power equipment at its new plant additions, comprising six buildings, to cost about $2,000,000.

EAST LANSING, MICH.—Work has started on construction of the new power plant at the Michigan Agricultural College.

RIVER ROUGE, MICH.—The Peerless Portland Cement Company, Union City, plans to construct a power house at its pro-

posed local cement mill, to cost about $3,500,000.

HAMILTON, OHIO.—An ordinance has been passed by the City Council authorizing the sale of the municipal electric plant to the Union Gas & Electric Company, Cincinnati. Under the terms of the contract the company will furnish power to the city for a period of twenty-five years. The construction of the proposed new plant, for which $650,000 in bonds had been issued will be abandoned.

LORAIN, OHIO.—Plans are being prepared by the Ohio Public Service Company for the erection of a high-tension line from Lorain to Mansfield, and also for a line to Ashland.

YOUNGSTOWN, OHIO.—Electric power equipment will be installed by the Truscon Steel Company at its proposed plant additions, to cost about $400,000.

MADISONVILLE, KY.—Plans are under consideration by the Kentucky Utilities Company, Louisville, and the Central Illinois Public Service Company, Springfield, Ill., for extending their transmission lines, connection to be made at Morganfield.

PAINTSVILLE, KY. — Extensions are contemplated to the waterworks, including the installation of electrically operating pumping machinery, to cost about $50,000.

LAFAYETTE, IND.—The board of directors of Purdue University has awarded a general contract to A. E. Kemmer, Lafayette, for the erection of a power plant and electrical building at the institution, to cost $100,000 and $105,000, respectively, including machinery, for which awards will be made at an early date. A project for the construction of a high power transmission laboratory at the institution will be held in temporary abeyance.

CHANDLERVILLE, ILL.—The Central Illinois Public Service Company has acquired the local municipal electric plant, with twenty-five-year lighting franchise. A transmission line will be erected from Virginia, about 12 miles, and a local substation installed, at a cost of about $30,000. Service at the municipal plant will be discontinued.

BRUCE, WIS.—The Byllesby Engineering & Management Corporation, 208 South La Salle Street, Chicago, has purchased the water power rights of the Chippewa River Power & Fiber Company, between Bruce and Radisson.

ELKHORN, WIS.—Preparations are being made by the Wisconsin Butter & Cheese Company to install an electric generator and a 50-hp. steam engine to generate electricity for light and power for its plant.

LUCK, WIS.—An agreement has been made whereby the electric systems of the Luck (Wis.) Light & Power Company and the Frederic (Wis.) Light & Power Company will be interconnected. The transmission line of the Luck company, which connects Cumberland and Luck, will be extended a distance of 20 miles and will furnish electricity in Frederic and Lewis.

TOMAHAWK, WIS. — The Tomahawk Kraft Paper Company will install electric power equipment in connection with plant additions to cost about $100,000.

DULUTH, MINN.—The Minnesota Power & Light Company has issued $8,300,000 in bonds, part of the proceeds to be used for extensions and improvements.

CEDAR RAPIDS, IOWA. — The Iowa Railway & Light Company contemplates building an addition to its power house and installing new machinery.

CEDAR RAPIDS, IOWA.—Plans are being considered by the Southern Iowa Public Utilities Company for extensions and improvements to its system.

COUNCIL BLUFFS, IOWA.—The Citizens' Gas & Electric Company contemplates extensions and improvements to its system, to cost about $250,000.

DAVENPORT, IOWA.—A site has been acquired on the Mississippi River, above Davenport by the United Light & Railways Company on which it proposes to build a power plant which will ultimately cost about $12,000,000. The initial unit will cost $2,500,000. Electricity will be transmitted to Davenport, Rock Island, Moline and East Moline.

MUSCATINE, IOWA. — The Muscatine Lighting Company has applied for permission to rebuild its distribution in Wilton.

SHENANDOAH, IOWA.—At an election held recently the proposal to issue $175,000 in bonds for a municipal electric plant was defeated.

SIOUX CITY, IOWA.—The Sioux City Gas & Electric Company plans to build a new generating plant to cost about $3,000,000. The transmission system will be extended in Northwestern Iowa and Eastern Nebraska.

WASHINGTON, IOWA.—The date for receiving bids for improvements to waterworks has been extended from Dec. 6 to Dec. 14. The works consists of brick building, electrically driven pumps, piping and equipment and a 200,000-gal. elevated tank, etc. Arthur L. Mullergren, Gates Building, Kansas City, Mo., is consulting engineer.

KANSAS CITY, MO.—The Illinois Power & Light Corporation has secured a controlling interest in the Kansas City Power & Light Company and contemplates extensions in the transmission system, etc.

FREMONT, NEB.—Work will soon commence on the installation of a municipal electric plant, to cost about $100,000, for which bonds have been voted.

FULLERTON, NEB.—The Nebraska Gas & Electric Company contemplates raising the voltage on its Fullerton-Central City transmission line (20 miles) from 16,500 to 33,000.

KANSAS CITY, KAN.—Electric power equipment will be installed in the proposed local plant to be erected by the Pittsburg Marble Works, Pittsburg, Kan., to cost about $100,000.

Southern States

HENDERSON, N. C.—Steps have been taken by the Chamber of Commerce for the installation of an ornamental lighting system on Garnett Street from Horner to Young Street.

LAURINBURG, N. C.—Bids will be received by the Mayor and Board of Town Commissioners until Dec. 18 for waterworks improvements, including pumping station, filter house and filter tubs, auxiliary station, storage basin, water tank and tower, 3½ miles of 6,600-volt transmission line, motor-driven centrifugal pumps and accessories, filter-plant equipment, etc. The Gilbert C. White Company, Durham, is engineer.

RALEIGH, N. C.—Plans are being prepared for a new power plant of about 1,000 hp. capacity for the North Carolina State College of Agriculture and Engineering. The plant will also be equipped as a testing station for students at the institution. J. E. Sirrine & Comany, Greenville, S. C., are engineers.

WILMINGTON, N. C.—The Wilmington Wood Products Company plans to install electric power equipment at its proposed plant in the Love Grove district, to cost about $85,000.

AIKEN, S. C.—Plans are under consideration for the installation of an ornamental lighting system on Park and Hayne Avenues. E. C. Lowe is interested in the project.

SAVANNAH, GA.—Plans are under consideration to establish a municipal electric plant, with transmission system, to cost about $1,500,000. Lawrence Manning is engineer.

MOSS BLUFF, FLA.—Plans have been completed by J. D. Young, Leesburg, for the construction of an electric plant and transmission line, for which contracts have been awarded. The company contemplates installing an addition unit of 500 hp. later. Victor G. Johnson is construction engineer.

ST. PETERSBURG, FLA.—Bids, it is understood, will be opened by the West Central Association, 11 Fifth Street, North, in about thirty days for the installation of an ornamental lighting system, covering about 7 miles.

CHATTANOOGA, TENN. — Work will soon begin by the Cumberland Telephone & Telegraph Company on the construction of a conduit on East and West Seventh Street, to replace its overhead wires. Extensions and improvements, involving an expenditure of $174,000, during the coming year are contemplated by the company.

MOBILE, ALA.—Bids will be received by the Supervising Architect, Treasury Department, Washington, D. C., until Dec. 17 for conduits, wiring and lighting fixtures for the local marine hospital.

PINE BLUFFS, ARK. — The Arkansas Light & Power Company has been granted permission to construct a hydro-electric plant on Little Red River in Clebourne County.

VAN BUREN, ARK.—The waterworks station now being built will be equipped with electrically operated pumps. Electricity will be furnished by the Fort Smith (Ark.) Light & Traction Company.

GIBSLAND, LA.—A special election will be held Dec. 4 to vote on the proposal to issue $60,000, in bonds, part of the proceeds to be used for the installation of a street-lighting system. E. T. Archer & Company, New England Building, Kansas City, Mo., are engineers.

OAK GROVE, LA.—Plans are being considered by the City Council for the installation of a municipal electric plant and waterworks system.

CANTON, OKLA.—The installation of electrically operated pumping machinery at the proposed municipal waterworks is under consideration. V. V. Long & Company, Colcord Building, Oklahoma City, are engineers.

CORSICANA, TEX. — Plans are under way by the Texas Power & Light Company, Dallas, to erect a high-tension transmission line from Corsicana to Tyler, to cost about $300,000.

DALLAS, TEX. — The Theater Electric Light Company, recently organized, has leased property at 208 North Akard Street, where it will establish an electric light and power plant for service to theaters in this section. L. G. Bissinger is secretary and treasurer.

GILMER, TEX.—The American Public Service Corporation has acquired the plant of the Gilmer Ice & Electric Company, and plans to erect a transmission line from Longview to furnish service at Big Sandy, Alba, Winnsboro and vincity.

ROTAN, TEX.—The Universal Gypsum Company, Fort Dodge, Iowa, plans to erect a power house at its proposed local plant, to cost about $250,000. C. T. Murphy is engineer in charge.

SAN ANGELO, TEX.—C. C. Holder plans to operate a local light and power plant for commercial service. A distributing system will be installed.

SEYMOUR, TEX. — The Wichita Falls (Tex.) Electric Company has acquired the plant of the Seymour Light & Ice Company and plans to erect a high-tension transmission line from Wichita Falls to Seymour to furnish electricity here. It is proposed to supply electricity to towns along the proposed line and also to extend the line to towns beyond Seymour.

WILLS POINT, TEX.—The Texas Power & Light Company, Dallas, has acquired the property of the Wills Point Electric Company, and plans to erect a high-tension transmission line from Terrill to Wills Point for local service.

Pacific and Mountain States

BELLINGHAM, WASH.—An ordinance has been passed authorizing a fund of $500,000 for the construction or purchase of a municipal electric plant and system.

CHEHALIS, WASH. — A franchise has been granted the North Coast Power Company to extend its transmission line Coal Creek to the Swayne property.

PORT ANGELES, WASH.—The Washington Pulp & Paper Corporation will install electric power equipment in its proposed new sulphite mill, to cost about $500,000, with other plant extensions and betterments.

SEATTLE, WASH. — The Puget Sound Light & Power Company has tentative plans under consideration for the construction of a new generating plant, to cost about $4,000,000. Extensions and improvements are also contemplated in its system to cost about $1,000,000.

TACOMA, WASH.—Application has been filed with the State Hydraulic Engineer by Charles C. Garland and associates of Tacoma for permission to build a large hydro-electric plant on the Toutle River in Pierce County, to cost about $5,000,000.

VANCOUVER, WASH. — The Mackall-Paine Veneer Company contemplates the construction of a power house at its mill, to cost about $75,000.

WENATCHEE, WASH.—The Washington Coast Utilities Company is planning extensions and improvements to its system in Wenatchee during the coming year, to cost about $40,000. Plans are being prepared by the company for proposed new work, to cost about $100,000 additional.

WINLOCK, WASH. — The Independent Electric Company has been granted a franchise to erect a transmission line on the old Lewis County Road.

DIAMOND SPRINGS, CAL.—The California Door Company contemplates rebuilding its power house and mill, recently destroyed by fire with loss of about $150,000.

EL DORADO, CAL.—The Western States Gas & Electric Company, San Francisco, plans to install additional units at its local hydro-electric power plant, now in course of erection. The first unit will have a capacity of 27,000 hp.

LIVERMORE, CAL. — Bids will be received at the office of the United States Veterans' Bureau, Room No. 791, Arlington Building, Washington, D. C., until Dec. 22, for construction complete of infirmary, including administration, mess and kitchen building, recreation building, nurses' quarters, attendants' quarters, garage, storehouse, boiler house and laundry, occupa-

tional-therapy building, ambulance cottages, officers' quarters, including mechanical equipment and outside service lines. Separate proposals will be received for central heating plant, including boiler plant, and heating equipment for all buildings, electrical equipment, elevators, refrigerating plant, stack, pumping, water supply, etc.

NEWPORT BEACH, CAL.—Bids will be received by the city trustees until Dec. 3 for the installation of an ornamental lighting system on Thirty-sixth Street and Finley Avenue. Paul E. Kressly, H. W. Hellman Building, Los Angeles, is city engineer.

SALINAS, CAL.—The Coast Valleys Gas & Electric Company, recently acquired by H. M. Byllesby & Company, Chicago, Ill., contemplates extensions and improvements to its system.

SAN BERNARDINO, CAL.—Bids will be received by the City Council until Dec. 3 for the installation of an ornamental lighting ssytem on E Street from Fifth Street to Highland Avenue.

SAN FRANCISCO, CAL.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 18 for one motor-generator set and six transformers for the Mare Island Navy Yard. (Schedule 1629.)

SAN FRANCISCO, CAL.—Bids are being received by Bliss & Faville, Balboa Building, architects, for the construction of administration building, six cottages, laundry and power house on a site bounded by Twenty-eighth and Thirtieth Avenues, Vicente and Wawona Streets, for the San Francisco Protestant Orphan Asylum. The cost is estimated at $350,000.

SANTA MONICA, CAL.—Plans for extension of the Santa Monica, Boulevard, include the installation of ornamental lamps.

EVANSTON, WYO.—The County Commissioners have granted the Utah Power & Light Company, Salt Lake City, a franchise to erect transmission lines in Uinta County. The company is negotiating for the purchase of the property and franchises of the Evanston Electric Light Company.

Canada

VANCOUVER, B. C.—The City Council is considering making application to the Minister of Lands for an option on the Cheakamus power site.

WINKLER MAN.—Application has been made to the Manitoba Hydro-Electric System to extend the transmission line from Morden to Winkler, a distance of 8 miles.

WINDSOR, ONT.—The Michigan Central Railway Company has contracted with the Windsor Hydro-Electric Commission for electricity (1,300 hp.) to serve the ice plant being erected in its Windsor yards.

CHICOUTIMI, QUE. — The Donnacona (Que) Paper Company contemplates building a hydro-electric plant near here.

MONTREAL, QUE.—The Ottawa River Power Company, Ltd., has awarded a general contract for construction of a dam and power house at Calumet Island Falls, near Bryson, Que. William Kennedy & Sons, Ltd., Montreal, and Dr. L. A. Herdt are engineers. William Kennedy, Jr., will purchase the hydraulic machinery and Dr. L. A. Herdt will buy the electrical machinery.

MONTREAL, QUE.—Plans, it is understood, are being considered by a group of financial men associated with the Montreal Tramways Company for a hydro-electric development on the Rivière du Loup, near St. Paulin, in the County of Maskinonge, about 70 miles northeast of Montreal. The plans include a dam and power house with an initial output of 21,000 hp. to be increased by later extensions.

THREE RIVERS, QUE.—Plans are being prepared by the North Shore Power Company for the construction of a hydro-electric plant and mill on the River Batiscan, to develop 5,000 hp. J. C. Smith, Montreal, is engineer.

Miscellaneous

HONOLULU, HAWAII.—Extensions and improvements involving an expenditure of about $1,250,000 are contemplated by the Hawaiian Electric Company, Ltd. The work will include increasing the output of the plant to 35,000 kw., the installation of a new 12,500-kw. steam turbo-generator unit, two 826-hp. boilers, fuel-oil-heaters, etc. The company has entered into a contract with the Honolulu Rapid Transit Company to furnish electricity to operate the car lines and will erect a 11,000-volt feeder lines to the power station of the transit company. Extensions to its lines in the sugarcane plantation and other industrial districts on the island of Oahu are to be made. A new substation will be erected at Waikiki.

Electrical Patents

Announced by U. S. Patent Office

(Issued Nov. 6, 1923)

1,473,417. RADIO RECEIVING APPARATUS; F. G. Beetem, Philadelphia, Pa. App. filed June 16, 1920. Control for tube filaments.

1,473,433. CARRIER-WAVE TRANSMISSION SYSTEM; A. W. Kishpaugh, East Orange, N. J. App. filed May 3, 1921. Remote control of high-frequency oscillations.

1,473,485. SOUND-PRODUCING MECHANISM; F. B. Little, Chicago, Ill. App. filed Oct. 20, 1921. Mechanism for suspending and operating tubular chimes.

1,473,504. RAIL CLAMP; R. E. Neely, Terre Haute, Ind. App. filed Dec. 23, 1922. Securing trolley wire insulators to supporting beams in mines.

1,473,567. TROLLEY LOCK; W. M. Lauer, Glenns Falls, N. Y. App. filed May 15, 1923. For retaining trolley wheel in proper relation to wire.

1,473,585. IGNITION DEVICE FOR AUTOMOBILES; H. R. Patterson, Toledo, Ohio. App. filed July 9, 1917. Condenser arrangement for ignition circuit.

1,473,586. ELECTRIC POWER PLANT; H. R. Patterson, Toledo, Ohio. App. filed Sept. 10 1919. Engine-driven storage-battery-charging set.

(Issued Nov. 13, 1923)

15,722 (reissue). SYSTEM FOR PRODUCING MODULATED WAVES; R. A. Heising, Millburn, N. J. App. filed Dec. 27, 1918. Radio-telephone transmitting system.

15,724 (reissue). METER; R. F. Schuchardt, Chicago, Ill. App. filed July 5, 1919. Measures kilowatts, kilovolt-amperes, maximum demand and power factor.

1,473,618. CARD-PUNCHING MACHINE; J. H. Gault, Philadelphia, Pa. App. filed June 9, 1920. Magnetically operated punches.

1,473,645. ELECTRIC HEAT DEVICE; T. C. Russell, Chicago, Ill. App. filed Sept. 18, 1922. Cooking unit.

1,473,671. TELEPHONE-EXCHANGE SYSTEM; J. Davidson, Jr., Trenton, N. J. App. filed Dec. 18, 1920. Machine-switching equipment controlled over toll lines.

1,473,674. MEANS FOR AND METHOD OF MODULATION; L. Espenschied, Queens, N. Y. App. filed Dec. 16, 1920. Transmission by carrier current.

1,473,682. REPEATER APPARATUS FOR CARRIER SYSTEMS; H. S. Osborne, New York, N. Y. App. filed July 24, 1919. Means for amplifying high-frequency carrier oscillations without disturbing low-frequency repeater.

1,473,719. RADIOTELEGRAPHY; R. R. Beal, Palo Alto, Cal. App. filed Feb. 19, 1920. System of single-wave radio signaling.

1,473,784. PROCESS OF ELECTRIC SMELTING AND FURNACE FOR SAME; J. C. Dow, Great Falls, Mont. App. filed July 6, 1920.

1,473,807. RECTIFIER; E. W. Breisch, Edgewood, Pa. App. filed Nov. 5, 1920. Means for smoothing out pulsations when single-phase source is employed.

1,473,809. TROLLEY BASE; L. F. Burnham, Fairport, N. Y. App. filed May 14, 1921. Two poles mounted on same base move independently of each other.

1,473,812. OUTLET-BOX CONSTRUCTION; N. T. Clements, Superior, Wis. App. filed May 12, 1920. Method of inserting armored cables.

1,473,856. SWITCH TERMINAL; H. D. James, Edgewood Park, Pa. App. filed April 9, 1919. Controller for heavy-starting-current motors.

1,473,862. THREE-PHASE REACTANCE COIL; A. Nyman, Wilkinsburg, Pa. App. filed June 19, 1918. Method of bracing coils.

1,473,865 to 1,473,867. ELECTRIC HEATER; S. I. Phelps, Rockford, Ill. App. filed Feb. 18, 1922. Electric cooking range.

1,473,881. NON-INDUCTIVE INTERFERENCE SYSTEM; C. F. Scott, New Haven, Conn. App. filed Dec. 2, 1918. Method of interrupting short-circuit current in single-phase railway to prevent induced voltage in nearby wires.

1,473,882. PICTURE TRANSMISSION; A. Sinding-Larsen, Vestre Aker, Norway. App. filed Sept. 16, 1919. Photo-electric cells with alkali metal cathode.

1,473,883. ELECTROLYTIC CONDENSER; J. Slepian, Wilkinsburg, Pa. App. filed Dec. 17, 1919.

1,473,900. ELECTRIC LIGHTING SYSTEM; J. B. Bushnell, Berkeley, Cal. App. filed Dec. 1, 1920. For automobile lights directly connected to generator.

1,473,915. RHEOSTAT; L. C. Martin, Providence, R. I. App. filed June 10, 1922. Spiral-wound wire with connector that makes contact by means of spiral groove over wire.

1,473,921. HIGH-FREQUENCY SIGNALING SYSTEM; J. Bethenod, Paris, France. App. filed May 6, 1922. Synchronizing connection for high-frequency alternators.

1,473,959. CIRCUIT-OPENING DEVICE; T. F. Johnson, Jr., Atlanta, Ga. App. filed Aug. 16, 1919. Automatic skeet switches.

1,473,960. THROW-OFF OR CIRCUIT-BREAKING SWITCH FOR SKEET HEADS; T. F. Johnson, Jr., Atlanta, Ga. App. filed May 13, 1920. For high-tension transmission lines.

1,473,977. HAIR-WAVING APPARATUS; O. Schaumberg, Pittsburgh, Pa. App. filed Dec. 5, 1921.

1,474,008. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; R. Stokely, Floral Park, N. Y. App. filed Dec. 8, 1920. Arrangement to take care of toll calls to and from full automatic offices.

1,474,014. ELECTRIC BELL; R. B. Benjamin, Chicago, Ill. App. filed March 1, 1919. All hammer-actuating mechanism inclosed in sealed casing.

1,474,015. LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 12, 1919. For locomotive headlights.

1,474,037. ALTERNATING-CURRENT MOTOR; H. W. Jeannin, Toledo, Ohio. App. filed March 18, 1919. Repulsion-induction type.

1,474,038. TELEPHONE REPEATER CIRCUITS; E. D. Johnson, East Orange, N. J. App. filed Jan. 4, 1918. Repeater automatically connected in correct direction by voice current.

1,474,053. TELEPHONE METER; E. H. Martin, Los Angeles, Cal. App. filed Sept. 25, 1920. For measuring time receiver is in service.

1,474,060. RHEOSTAT; A. E. Waller, Bronxville, N. Y. App. filed Dec. 31, 1920. For electroplating processes capable of carrying heavy currents.

1,474,094. SWITCH DRUM FOR STARTING AND CONTROLLING ELECTROMOTORS; L. Schön, Essen, Germany. App. filed Sept. 26, 1922. Ratchet arrangement to prevent damaging contact when shut off.

1,474,100. AUXILIARY MOUTHPIECE FOR TELEPHONES; O. W. Aagaard, Chicago, Ill. App. filed Jan. 19, 1922. Flexible mouthpiece to conform with each individual mouth.

1,474,104. ELECTRIC WATER HEATER; W. E. Burgess, New Orleans, La. App. filed June 15, 1922. Placed directly in water-pipe line.

1,474,151. ELECTRODE FOR ION CONCENTRATION EFFECTS; E. A. Keeler, Norristown, Pa. App. filed Nov. 30, 1921. For measuring ion concentration.

1,474,152. INDUCTION COIL; A. A. Kent, Ardmore, Pa. App. filed Jan. 8, 1921. For internal-combustion engines.

1,474,153. MEANS FOR DETACHABLY CONNECTING AN OPERATING MEMBER TO A POWER-DRIVEN SHAFT; B. W. Klein, Mount Vernon, N. Y. App. filed Oct. 16, 1922. Connecting polishing brush to flexible shaft of shoe-polishing machine.

1,474,169. AUTOMATIC WATER FILTER FOR STORAGE BATTERIES; J. D. Sartakoff, Forest Hills, and W. V. Forrest, Brooklyn, N. Y. App. filed Nov. 5, 1920. Electrolyte automatically maintained at predetermined point.

1,474,172. ELECTRIC MEASURING INSTRUMENT; W. M. Scott, Cleveland, Ohio. App. filed Dec. 10, 1919. Ammeter for automobile.

1,474,186. SANITARY ATTACHMENT FOR TELEPHONE TRANSMITTERS AND THE LIKE; C. P. Abbott, Allston, Mass. App. filed June 19, 1922.

1,474,199. UNIVERSAL POINT AND CARRIER FOR WELDERS; F. P. McBerty, Warren, Ohio. App. filed June 30, 1921. Facilitates welding at any angle.

1,474,241. TROLLEY SHEAVE; J. J. Crapper, Brooklyn, N. Y. App. filed March 29, 1923. Guard for preventing displacement of trolley wire.

1,474,242. ACOUSTIC RECEIVING APPARATUS; C. A. Culver, Beloit, Wis. App. filed Oct. 23, 1919. Transmuting electrical impulses into audible sounds.

1,474,256. INSULATOR; W. T. Goddar, Victor, N. Y. App. filed March 14, 1917. Method of insulating coiled inductances.

1,474,293. THERMIONIC VALVE; F. Reynolds, Walkerville-on-Tyne, England. App. filed Nov. 10, 1921. Method of supporting electrodes.

1,474,304. ELECTRIC TABLE LAMP WITH BRAKE-CONTROLLED SUPPORTING ARMS FOR INCANDESCENT LAMPS; G. Weber, Egelsbach, Germany. App. filed Dec. 29, 1921.

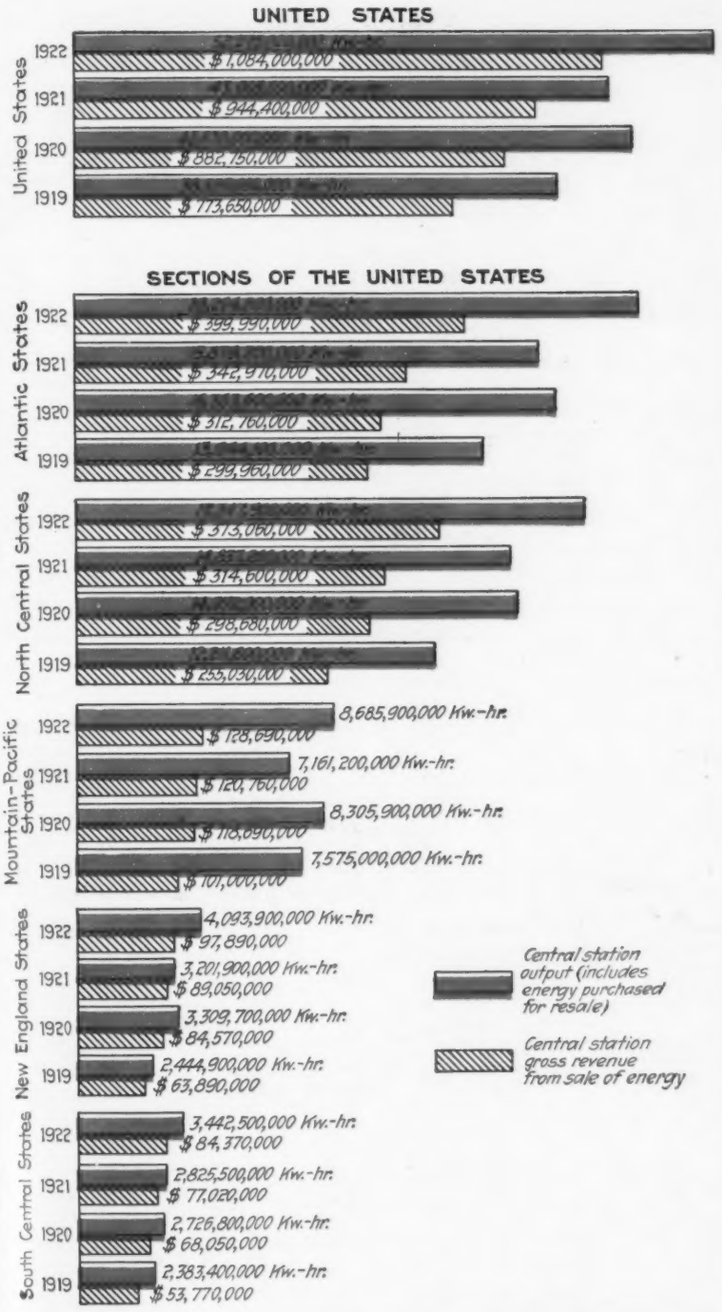
1,474,312. ELECTRIC CONTROL MECHANISM; C. W. Wyman, Claremont, N. H. App. filed Sept. 5, 1919. Motor starter.

1,474,313. STORAGE BATTERY; J. M. Allen, St. Louis, Mo. App. filed Nov. 29, 1920. Positive plates connected in pairs to prevent buckling.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

No Section of the Country Has Ever Reported a Decrease in Annual Gross Revenue



Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote or use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.

The Relation of Revenue to Output

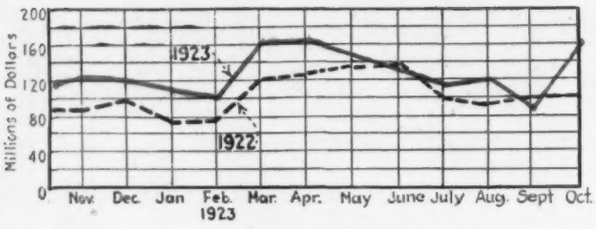
IN STUDYING the relation which exists between central-station revenue and output in various sections of the country it is necessary to have a clear view of lighting and power conditions as they exist in those sections, as well as the economic conditions entering into the generation of the energy. Because a system in one section of the country reports an output double that of a system in another section it does not follow that the revenue of the first system is double or even equal that of the second system.

Out on the Pacific Coast, and in a large portion of the Mountain States, load conditions are such that the electric public utilities enjoy high yearly load factors which make for low rates. Coupled with this is the fact that in these two sections almost 87 per cent of the energy is generated in favorably located hydro plants. About 80 per cent of this hydro-electric energy is consumed by high-load-factor power users and only 20 per cent is used by low-load-factor but high-revenue lighting customers. Mass production of energy is, therefore, prevalent.

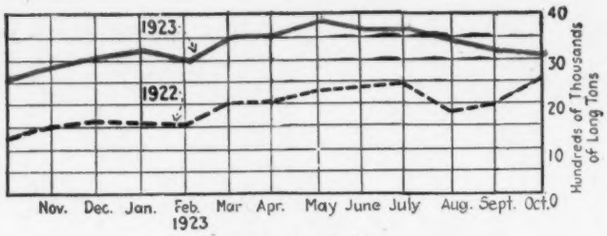
On the other hand, controlling conditions in the North Central States result not only in a large output of energy but also in a comparatively high revenue. The utilities there do not operate on such high yearly load factors, and, besides, almost 83 per cent of the energy used in that section is produced in steam-electric plants, which, with their higher cost of operation, call for comparatively higher rates for energy. In that section, also, about 32 per cent of the energy is consumed by low-load-factor, high-revenue lighting customers and 68 per cent by high-load-factor, low-revenue power customers. All these conditions result in comparatively high revenue for the systems in the North Central States.

In the last analysis, however, there is little difference between the relation of net revenue to the investment of central-station systems in the various sections of the country, the regulatory authorities basing rates upon conditions as they exist in the various systems.

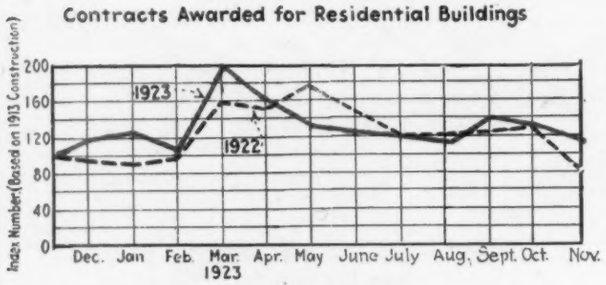
How the Primary Industries Are Trending



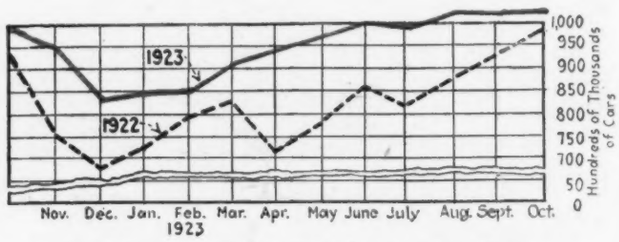
Contracts Awarded for Residential Buildings



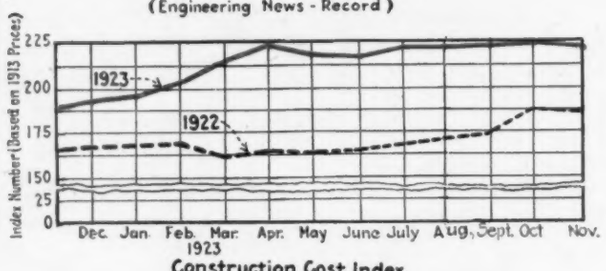
Pig-Iron Production



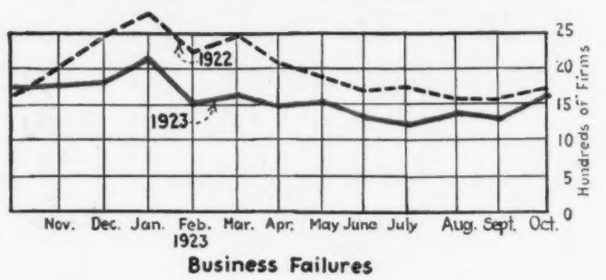
Construction Volume Index
(Engineering News-Record)



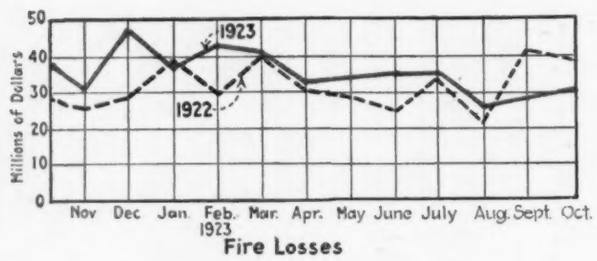
Total Average Weekly Freight-Car Loadings



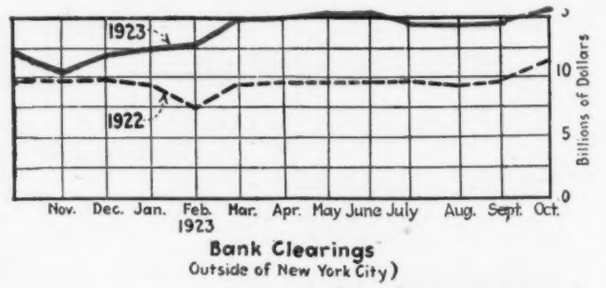
Construction Cost Index
(Engineering News-Record)



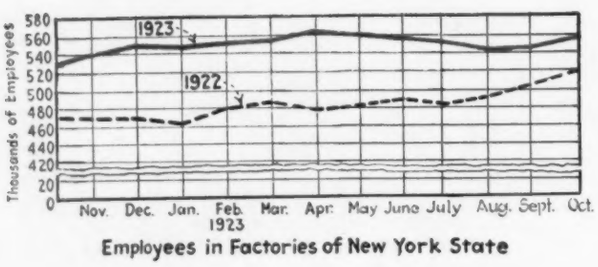
Business Failures



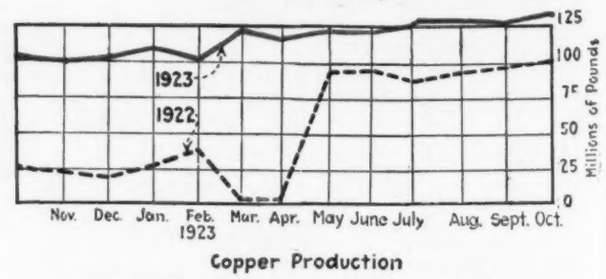
Fire Losses



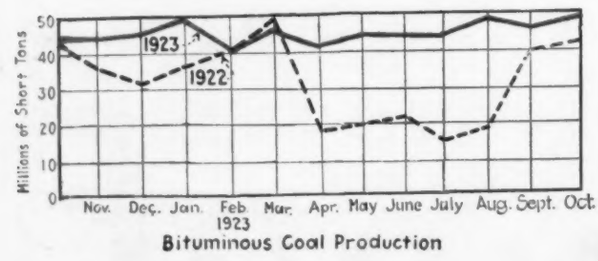
Bank Clearings
Outside of New York City)



Employees in Factories of New York State



Copper Production



Bituminous Coal Production

Optimistic Outlook for 1924

THE question, "What has 1924 in store for business?" is a most important one just at this time among manufacturers and distributors. The Harvard University Committee on Economic Research sums up the situation as follows: "We forecast improvement in business during the first half of next year, with generally firm and rising commodity prices, expanding operations and activity, and a normal manufacturing output."